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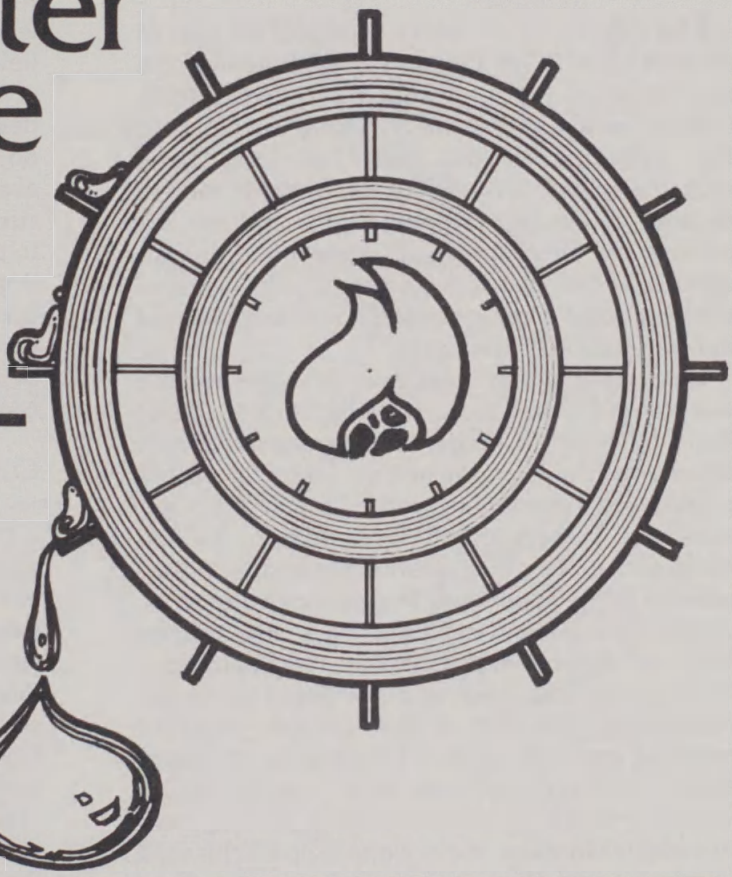
In This Issue

Water Use and Coal Development in Eastern Montana



PAUL E. POLZIN

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This article is taken from Dr. Polzin's study, *Water Use and Coal Development in Eastern Montana*, done in cooperation with the Montana University Joint Water Resources Research Center, Bozeman, and funded in part by the U.S. Department of the Interior, Office of Water Resources Research, as authorized under the Water Resources Research Act of 1964, Public Law 88-379, as amended. The complete report is available from the Bureau of Business and Economic Research, University of Montana, Missoula, or from the Montana University Joint Water Resources Research Center, Bozeman.

I. THE SETTING

The coal fields of eastern Montana are part of the Fort Union Coal Region which stretches from the Canadian border through Montana, North Dakota, South Dakota, and Wyoming (see figure 1). The existence of this coal has long been recognized, but little has actually been mined. Because of the recent energy crisis and the imposition of environmental controls on urban utilities, whose electric generating plants are one of the major coal users, interest has now reawakened in Montana's coal resources.

The severity of current energy shortages and the vast potential supplies of coal in the Northern Great Plains have led to predictions of mammoth new developments accompanied by increased population, instant cities, and a "boom and bust" economy. These specters have, in turn, divided much of the state into factions supporting or opposing coal development. The ensuing arguments, charges, and countercharges have often been bitter and acrimonious. Unfortunately, many have been purely emotional and not based on sound foundation. The fact is that despite pages of editorial comment and public pronouncements, there has been precious little analysis of the economic implication of coal-related development in eastern Montana. We hope to help fill this void by taking a cold, hard look at coal development and what it implies for the economy and people in the region. We do not pretend to have all the answers; but perhaps this study will provide the first stage for a continuing series of projects concerned with the economic consequences of coal-related development in eastern Montana.

This study will not take sides; it is neither pro nor con with respect to coal development. Rather, we present our findings in the hope they will provide sound input for policy decisions and an informed populace. Also, our scope of inquiry is limited. We are concerned only with the economic aspects as represented by aggregate measures, such as population, employment, and income. We are not experts in pollution, agronomy, or interpersonal relations, and will have little to say about these topics. Yet we recognize they are an integral part of the overall problem and hope that similar reports will be prepared by qualified individuals in these fields.

An economic analysis of coal-related development is neither simple nor precise. Events do not happen in a vacuum; they depend on other events and conditions occurring before or concurrently. Thus, a major goal of this study is simply to put coal development in its proper perspective. With this in mind, we begin by examining the current situation with respect to coal production in eastern Montana and then turn to Montana's role as an energy source by discussing the uses for our coal.

Current Coal Production

Coal mining is not new to Montana. From the late eighteen hundreds to the nineteen-fifties, the Northern Pacific Railroad (now the Burlington Northern, Inc.) used Montana coal to fire its locomotives—first from underground mines near Red Lodge and then, after World War I, from a surface mine located near what is now called Colstrip.[1] Also, there have been numerous small underground mines, especially in the Roundup area, which served primarily local markets. Many of these are now closed, largely due to declining demand.

The renewed interest in Montana coal is centered on deposits lying near the surface which can be strip mined. Glancing at figure 1, we see that strippable deposits dot eastern Montana from Sheridan County in the north to Powder River and Big Horn counties on the Wyoming border.[2] However, looking only at potentially strippable deposits paints an exaggerated picture because, with one exception, all operating mines are south of the Yellowstone River in Rosebud and Big Horn counties.

[1]William B. Evans, "Public Response to Strip Mining in Montana, 1920s to 1973," *Montana Business Quarterly* (Summer 1973), p. 17.

[2]Figure 1 is already out of date. Many additional deposits, especially in Rosebud and Big Horn counties, have recently been mapped.

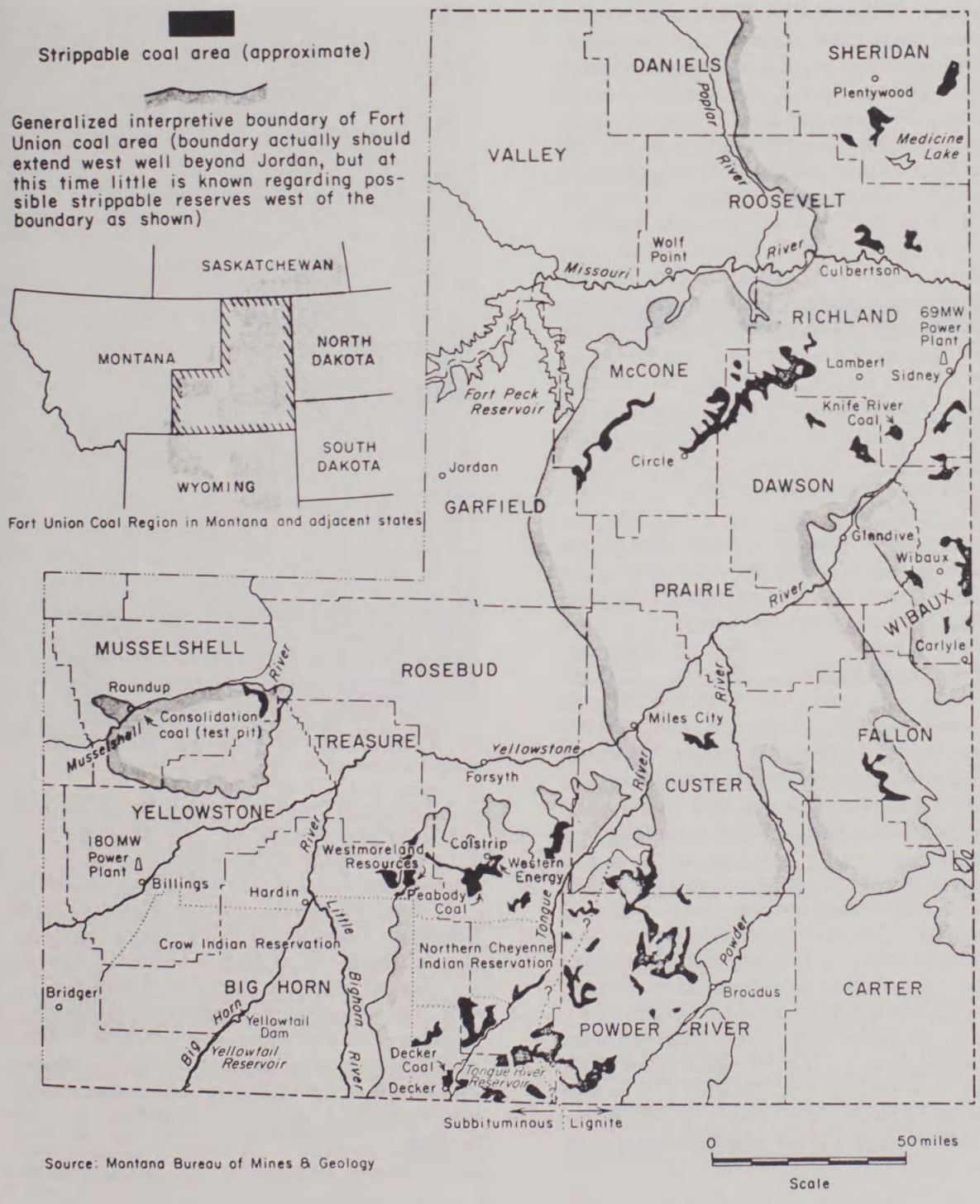


Figure 1. Fort Union coal area in eastern Montana

Table 1 reports that coal production in Montana has grown from 371,000 tons in 1967 to almost 11 million tons in 1973. Most of this increase can be attributed to three mines: the Rosebud mine operated by Western Energy Company (a subsidiary of Montana Power Company) on the old Northern Pacific site near Colstrip, the Big Sky mine operated by Peabody also near Colstrip, and the Decker mine at Decker in southeastern Big Horn County. In addition, the Knife River Coal Company in Richland County produces about 325,000-350,000 tons annually which are used exclusively to power the Montana-Dakota Utilities' generating plant near Sidney. These four mines accounted for about 10,636,000 of the 10,665,000 tons of coal produced in Montana during 1973, suggesting that the smaller mines have all but disappeared.[3] A fifth mine, Westmoreland Resources at Sarpy Creek in eastern Big Horn County, is scheduled to begin operation during 1974.

Most of the approximately 11 million tons of coal mined during 1973 was shipped via unit train to Midwestern utilities. We do not have precise data concerning Montana coal consumption, but we know that the major current users are the Montana-Dakota generating plant at Sidney, at 325,000-350,000 tons per year, and Montana Power's Corette plant at Billings, receiving about 500,000 tons per year from Western Energy's Rosebud mine. Subtracting this 850,000 tons from the total of 10,665,000 tons produced during 1973 suggests that about 9,800,000 tons of coal were exported from the state.

The significant rise in coal production has been accompanied by associated increases in mining employment. Unfortunately, we also do not have exact data concerning the number of miners; several of the coal companies have subcontracted their mining operations to construction and heavy equipment companies and these employees have, until recently, been mistakenly classified in other industries. The Employment Security Division of the Montana Department of Labor and Industry estimates that average annual employment in coal mining was about 400 workers during 1973; with the exception of about 20 to 25 miners in Richland County, almost all of the remainder worked at the large mines in Rosebud and Big Horn counties.[4]

Table 1

Montana Coal Production
1967-1973

Year	Short Tons
1967	371,000
1968	519,000
1969	1,030,000
1970	3,447,000
1971	7,064,000
1972	8,221,000
1973	10,665,000

Sources: U.S. Department of the Interior, Bureau of Mines, "The Mineral Industry of Montana," 1968-1973, *Mineral Industry Surveys* (Washington, D.C.), table 1; and Montana Department of Revenue, Property Assessment Division, unpublished data (Helena, Montana).

In summary, dramatic increases in coal production are not something that are going to occur in the far distant future. Right now about 400 miners are producing almost 11 million tons per year. But strip mines are not scattered over the length and breadth of eastern Montana—with one exception, they are all located in rural portions of Rosebud and Big Horn counties. This, as we will see later, both simplifies and complicates our economic analysis.

[3]Montana Department of Revenue, Property Assessment Division, unpublished data (Helena, Montana).

[4]Montana Department of Labor and Industry, Employment Security Division, unpublished data (Helena, Montana).

Montana's Role in the National Energy Picture

Coal for Export

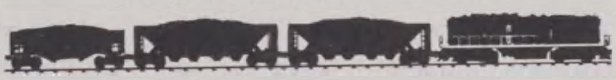
The export demand for Montana coal may be attributed to two factors: (1) its low-sulfur content, which makes it attractive for utilities where burning of high-sulfur coal is restricted, and (2) the low cost of its extraction. Much of the coal in Montana is situated in large, thick seams which are ideal for surface mining. The fact that the coal is available in large quantities from small areas makes it possible for large long-term contracts to be filled from operations in one general location.[5]

During the late sixties and early seventies, environmental legislation required a number of large Midwestern utilities to reduce the sulfur content of the coal burned in generating plants. The utilities' solution has been to mix low-sulfur Montana coal with high-sulfur Midwestern coal in order to meet the emission requirements. A number of methods are currently under development to remove the sulfur associated with burning Midwestern coal.[6] If and when these processes become operational, Montana will lose the advantages due to the low-sulfur content of its coal.

The long-run export demand for Montana coal will be determined by its cost vis-a-vis coal mined in other areas of the country. In its favor, Montana coal is found in thick seams located near the surface, leading to low extraction costs. On the other hand, Montana coal has relatively low heating value (it requires more coal to extract a given amount of energy) and it is located far from the major coal consumption centers. Illinois, the largest user of coal for electrical generation, is about 900 rail miles from the mines. Missouri and Wisconsin are equally distant. Minnesota, Kansas, and eastern Nebraska are about 600 miles away.[7]

[5]Montana Bureau of Mines and Geology, "Markets for Montana Coal," *Preliminary Summary Report of Strippable Low-Sulfur Coals for Southeastern Montana*, pt. 2 (Butte, Montana: Montana College of Mineral Science and Technology, August 1970). The economic information in part 2 was prepared by Cameron Engineers (Denver, Colorado) for the Montana Bureau of Mines and Geology.
[6]*Great Falls* (Montana) *Tribune*, December 18, 1973, p. 5.
[7]Montana Bureau of Mines and Geology, "Markets for Montana Coal," pp. 9 and 13.

Unit trains, with their associated lower rates, are presently the most economical method of transporting Montana coal to their markets. Using all the cost advantages now available, however, transportation still constitutes the greatest share of the delivered price of coal mined in Montana. For example, almost 75 percent of the cost of Montana coal delivered in Chicago is attributable to railroad charges.[8]



If the sulfur problem is overcome, many utilities may revert to their original suppliers. Cost analysis suggests that, given present conditions, Montana coal, even with its lower heating value, may nevertheless be competitive in certain areas in the Upper Midwest.[9] If the cost of Midwestern coal rises, Montana coal may become even more attractive. The Coal Mine Health and Safety Act of 1969 has resulted in significant cost increases in underground mines and growing amounts of Midwestern coal are being extracted underground.[10]

In summary, the current export demand of Montana coal is, to a large extent, due to its low-sulfur content. The sulfur problems will probably be overcome, however, and the long-run demand for Montana coal will depend on the availability of low-cost transportation and on developments in coal-producing areas closer to the consuming markets.

Electrical Generation

A second use of Montana coal is the generation of electricity in large mine-mouth plants. Current and anticipated advances in the technology of high-voltage electrical transmission would allow this power to be fed into a regionwide grid and then channeled to the ultimate consumers, mostly located in large metropolitan areas.

[8]*Ibid.*, pp. 19-21.
[9]*Ibid.*, pp. 25-26.
[10]*Ibid.*, p. 27.

The controversial North Central Power Study identified twenty-two sites in eastern Montana as having the potential for large mine-mouth generating plants.[11] The number of plants which will actually be built is open to question. In order to understand this uncertainty and its implications for Montana, we will look at certain assumptions underlying the projections of future electrical generating projects.

The use of electricity in the United State has been doubling every ten years. Current practice has been to extrapolate this rate of growth in order to estimate the demand for electricity in the future, and, given these demand estimates, to examine how this electricity may be supplied. The number of nuclear generating plants is expected to increase significantly in the latter part of this century. Even if nuclear generation proceeds at the maximum rate, there will be a gap between the projected demand for electricity and the supply which can be filled by conventional steam generating plants. This, then, is where Montana and its coal reserves enter the electrical generating picture.[12]

Although our purpose here is not to provide a detailed critique of the national energy projections, one feature of the previous line of reasoning merits examination: the assumption that electrical demand will continue to double every ten years. It is a fact that electrical consumption in the United States has grown at this rate in the past, but during this same period the price per unit of electricity has risen less quickly than other prices.[13] In other words, once the effect of inflation has been eliminated, the price per unit of electricity has actually been declining. No wonder its demand has increased at such a phenomenal rate!

[11]North Central Power Study, "Report of Phase 1," *North Central Power Study*, vol. 2 (Billings, Montana: U.S. Bureau of Reclamation, 1971), table B-1.3, p. VI-2C.

[12]This is heroic simplification of a very complex situation. Many of the subtleties and their important implications have been glossed over in the interest of brevity.

[13]Duane Chapman, Timothy Tyrrell, and Timothy Mount, "Electricity Demand Growth and the Energy Crisis," *Science*, vol. 178, no. 4062 (November 1972), p. 704.

There is considerable evidence that the price of electricity (corrected for inflation) will rise in the future and tend to dampen the historical rate of increase in demand. The rising prices of fuels burned in steam generating plants and the increased use of anti-pollution devices are among the factors that will increase the costs of producing electricity. If these increased costs are reflected in higher electrical prices, the rate of increase in electrical use will fall below the historical trend of doubling every ten years.[14] This suggests that many of the projected generating facilities may not, in fact, be needed.

Rising electrical prices are not likely to have a significant impact on the demand for electricity before 1985.[15] The United States is locked into a pattern of increased electrical use for the next decade or so; it takes time to install electrical conservation devices and to get out of the habits associated with "living better electrically." Thus, the need for increased generating capacity in the short run is real.

The future of nuclear power plants introduces additional uncertainty. The use of electricity is certain to increase, albeit at a slower rate due to its rising price. If nuclear generating plants are deemed unsafe or if other obstacles plague their development, the major source of increased electricity will be conventional steam generating plants; and, once again, the sites in Montana enter the picture.

One final aspect, environmental legislation and pollution controls, must be considered when talking about the future of electrical generation in Montana. Less stringent controls on pollution would certainly reduce some of the costs of conventional generating plants and would increase the attractiveness to utility companies of areas where such legislation is lax. The cost of pollution abatement is only one of the factors which must be weighed by utilities, however. Among others are the distance from raw materials and the distance from the market. We are presently unable to say just how important each of these factors is in determining the location of generating facilities.

[14]*Ibid.*, pp. 706-708.
[15]*Ibid.*, p. 706.

To summarize, the large number of mine-mouth plants predicted for Montana will materialize only if the national demand for electricity grows at historical rates and/or serious problems with nuclear plants are encountered. In the immediate future, the increased demand for electricity may give rise to a few proposals to locate new plants in Montana.

Synthetic Fuels

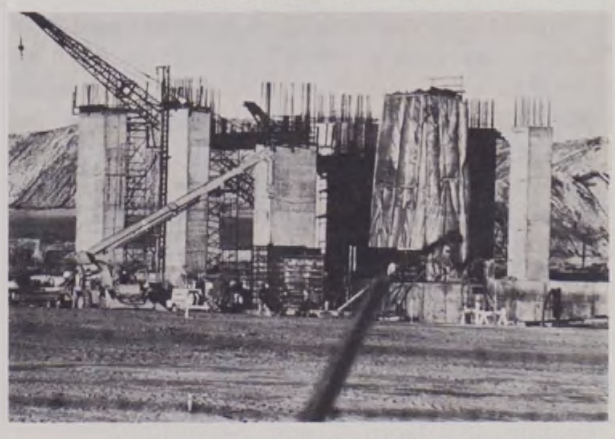
The final alternative use of Montana coal is in the production of synthetic crude oil and natural gas. In its ultimate form, this form of development would use coal to produce electricity, liquid and gaseous fuels, and petrochemicals.[16] Many of these processes are still in experimental form; only the production of synthetic natural gas—referred to as gasification—has been successfully accomplished outside a laboratory.

It is uncertain whether or not gasification facilities will be built in Montana before 1985. Much depends on the future price and demand for natural gas. At present, the wellhead price of natural gas has been regulated at a level many consider to be too low. This, in turn, has led to a rapid growth in the use of natural gas. The projected deficit between available supplies and future demand has led utility companies to investigate gasification of coal as an alternative supply. The cost of synthetic natural gas is far above the current regulated price at the wellhead. This price would have to more than triple to make gasification profitable. A rise in the price of natural gas, even if it is not fully reflected at the retail level, would lead to two countertrends: a declining rate of growth in the demand for natural gas, and increased exploration for other sources of supply; e.g., more intensive exploration or even liquefied natural gas from abroad. Both of these factors would tend to decrease the projected deficit and may make gasification of coal unnecessary.

[16]Montana Coal Task Force, *Coal Development in Eastern Montana* (Helena, January 1973), p. 17.

Competition with Other States

Interstate differences in pollution and tax laws also add to the uncertainty concerning the development of Montana's coal resources. The Fort Union coal area includes parts of eastern Montana, Wyoming, and North and South Dakota. In many aspects the areas of all four states are quite similar, with a number of the coal companies having holdings in more than one state, as well. Thus it is conceivable that tax or pollution action or inaction by one state may induce coal development in another. Unfortunately, the consequences of legislation are not always predictable.[17] Much depends on the exact form of the laws and their timing.[18] Further, the volatility of state legislatures is well known; a tax or pollution advantage/disadvantage can be quickly reversed in one legislative session. Thus, because so little can be said with certainty, we prefer not to speculate as to the direction of future legislation and its impact on coal-related development.



[17]During the debates concerning Montana's recent hike in the coal tax, it was asserted that the tax increase would make little difference to the buyers because it was such a small portion of the delivered price. This is probably true. But if a coal company could fill an existing contract from holdings in Montana or elsewhere, it would have an incentive to extract the coal where it is taxed least.

[18]High taxation or stringent pollution laws would have one effect on existing facilities, but an entirely different impact on projects not yet begun.

Summary

In this section we have attempted to place Montana and its coal reserves in the context of the national energy picture. The overriding feature is uncertainty. There are so many variables that an infallible prediction is impossible. One point deserves further emphasis: the three possible uses of Montana coal—for export, electrical generation, or gasification—are relatively independent of each other. That is, we may see rapid expansion of coal for export but little generation or gasification. Or, sulfur scrubbers may eliminate the need for Montana coal; generation facilities may be located elsewhere; but a number of gasification plants may be built in Montana to supply synthetic natural gas. Thus it is not enough to be concerned with the level of coal usage (the number of tons extracted). How the coal is used and the "mix" of coal development are also important determinants of the economic impact.

The Impact Area

An accurate economic analysis of the current and future coal-related development in Montana requires a delineation of the exact areas where most of the increases in employment and population will take place. Earlier we saw that, despite the presence of strippable coal deposits throughout eastern Montana, most existing mines and processing facilities have located near each other in several southeastern counties. We believe that this trend will probably continue into the next decade, and the majority of new mines, electrical generation, and gasification plants will be built in this area. Specifically, we have identified seven counties (Big Horn, Custer, Musselshell, Powder River, Rosebud, Treasure, and Yellowstone) which we will define as the economic impact area. That is, we expect that these counties will be the site of new mines and processing facilities along with most of the increases in population, income, and employment. This does not rule out coal-related development elsewhere in the state; but in order to conduct an orderly investigation, we had to reduce the study region to a manageable size, and this seven-county area is our best guess as to where the economic impact will be concentrated. Notice that Knife River Coal Company, whose mine is in Richland County, is excluded. Currently, that firm produces between 300,000 and 400,000 tons per year to fire the electrical generating plant at Sidney. Company officials do not anticipate increasing production. Consequently, this omission represents only a very small proportion of Montana's total coal production.

Three of the seven counties—Big Horn, Powder River, and Rosebud—have been singled out for special attention because they contain the most likely sites for the new mines and processing facilities. We have called them the three-county primary impact area.[19]

During the remainder of this report individual counties usually will not be discussed. Most of the analysis will be in terms of various totals for the three- and the seven-county impact areas. Thus, it is very important that the relationship between the two be clearly understood. As we have already noted, and as figure 2 indicates, the three-county primary impact area is part of the larger seven-county impact area. The major reason for analyzing both areas is that the latter (seven counties) encompasses the trade centers, Miles City and Billings, where much of the economic impact will take place.

[19]Once again, this does not rule out locations elsewhere in the region. However, the Northern Great Plains Resource Program, a consortium of federal agencies charged with examining coal-related development, has made studies of the entire area and found these sites most promising.

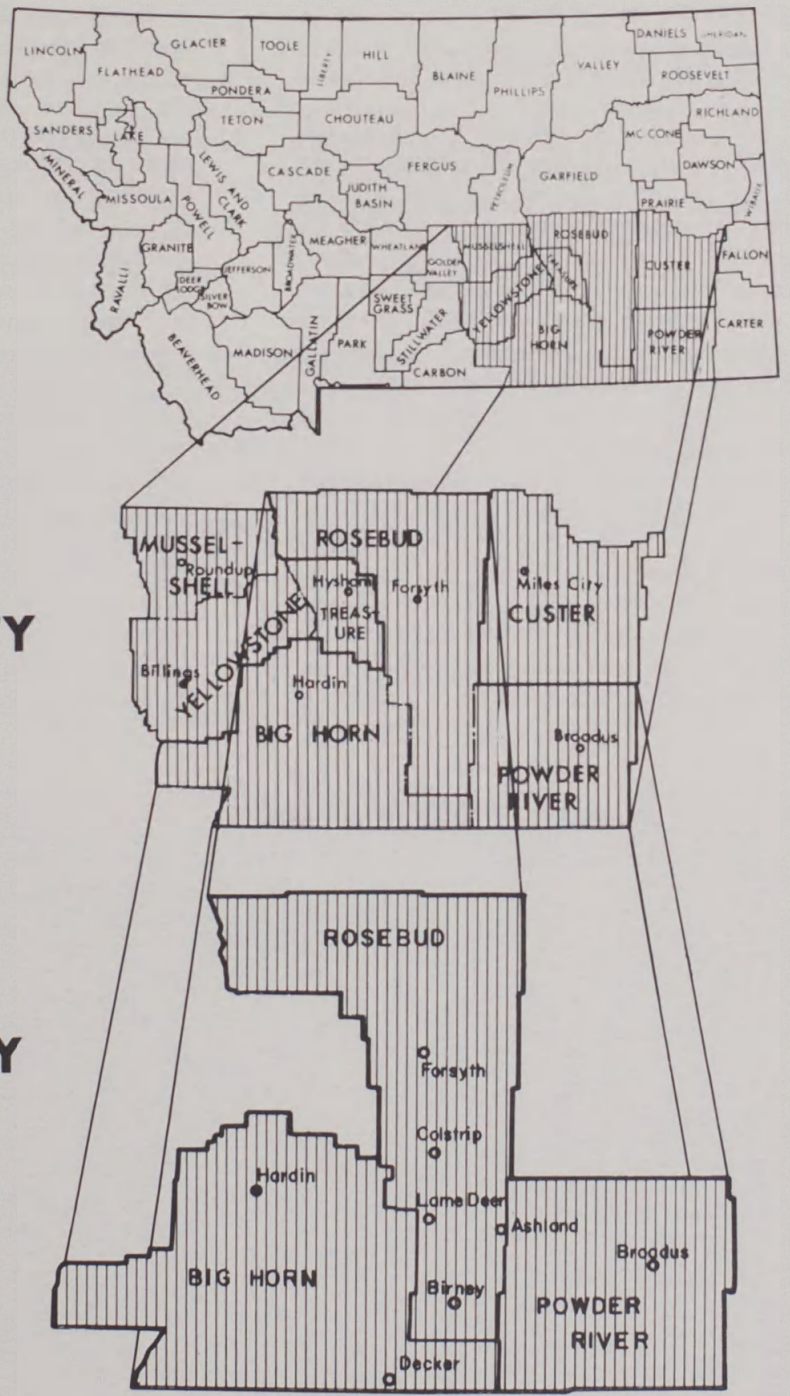


Figure 2. Impact areas

II. ISSUES CONCERNING COAL DEVELOPMENT

Before turning to the overriding issues and controversies related to coal development, we would like to review some of the ground rules within which we worked. Our projections are for 1980 and 1985. The future course of energy production is currently very uncertain, and we believe that looking beyond 1985 is mere speculation. Even limiting our horizon to the next six to eleven years is fraught with difficulties. However, we derived what we consider to be reasonable guesses (and they are just that, guesses) as to the course of development in 1980 and 1985, and they are presented in table 2. Notice that there are two alternative levels of development, which differ only with respect to gasification. This is the case because the future of gasification is uncertain; it may or may not materialize in Montana. At the same time, gasification plants will have, proportionately, the greater economic impact on the local area. Thus, two cases, one with and one without gasification, were given a complete analysis.

The new mines and processing facilities were assumed to locate in Big Horn, Powder River, or Rosebud counties, which we have called the three-county impact area. Specific sites were not identified. Much of the economic impact will be felt outside these counties. Consequently, analysis and projections were also made for a larger aggregate, called the seven-county impact area, which includes Big Horn, Powder River, Rosebud, Custer, Musselshell, Treasure, and Yellowstone counties.

It was assumed that all of the mines, electrical generating, and gasification plants listed in table 2 are in operation during the year specified and that no construction will be underway during 1980 or 1985. This is, of course, unrealistic. But it allows the transitory impact of construction activity to be separated from the more permanent effect of mines and processing facilities.

Table 2

Projected Alternative Levels of Coal Development with and without Gasification 1980 and 1985

	Alternative I (No Gasification)		Alternative II (With Gasification)	
	1980	1985	1980	1985
Montana coal production, total (millions of tons)	49.0	61.0	57.0	77.0
Shipped from Montana	39.5	47.5	39.5	47.5
Used for electrical generation[a]	9.5	13.5	9.5	13.5
Used for gasification	0	0	8.0	16.0
Additional electrical generation (installed megawatts)[b]	2,060	3,060	2,060	3,060
Gasification plants (250 million scfd)[c]	0	0	1	2

[a] Includes 0.5 million tons per year for the Corette plant but excludes 0.33 million tons mined in Richland County (Montana-Dakota Utilities Co.).

[b] Excludes the Corette plant.

[c] scfd denotes standard cubic feet per day.

How Many New Jobs Will be Created?

The introduction of a new industry, such as coal mining and processing, has both a direct and indirect impact on the number of employment opportunities in an area. First of all, there are the miners, electrical and gasification workers, and railroad employees directly concerned with the extraction, processing, and transporting of Montana coal. These positions are classified as primary jobs. Then, there are additional support personnel, such as shopkeepers, telephone operators, and school teachers, who will also be required to service the increased population; they are called derivative workers. Thus, the total impact on employment of the new coal-related activities is the sum of the primary and derivative jobs.

Table 3 presents our projections of the increase

Table 3

Projected Employment Opportunities under Alternative Levels of Coal Development in the Economic Areas 1980 and 1985

	Alternative I (No Gasification)		Alternative II (With Gasification)	
	1980	1985	1980	1985
Three-county impact area[a]				
Total employment	2,550	2,900	3,900	5,700
Primary	1,250	1,500	2,000	3,050
Derivative	1,300	1,400	1,900	2,650
Seven-county impact area[b]				
Total employment	5,550	6,450	8,000	11,250
Primary	1,550	1,800	2,300	3,400
Derivative	4,000	4,600	5,700	7,850

Notes: The projected employment opportunities exclude those resulting from any construction activity that is directly related to coal development; however, they do not exclude construction as a derivative industry. Detail may not add to the totals because of rounding.

[a] Big Horn, Powder River, and Rosebud counties.

[b] Big Horn, Powder River, Rosebud, Custer, Musselshell, Treasure and Yellowstone counties.

in employment opportunities due to new coal-related development. Two sets of projections are presented; the first corresponds to the case of no gasification plants (Alternative I) while the second (Alternative II) includes one gasification plant in operation by 1980 with a second on-line by 1985. Under the first alternative, we projected that there will be about 2,550 jobs in 1980 and 2,900 in 1985 directly or indirectly associated with coal development in the three counties (Big Horn, Powder River, and Rosebud). Expanding to the seven counties, which include Miles City and Billings, the total rises to 5,550 in 1980 and 6,450 in 1985. Assuming Alternative II, the employment related to coal development for the three counties is projected to be 3,900 in 1980 and 5,700 in 1985, while for the seven counties the corresponding figures are 8,000 and 11,250.

These employment projections are, at best, simply rough estimates and should be interpreted with a great deal of caution. However, granting that they are only approximations, they do point out several very important implications concerning coal-related developments. First of all, much of the impact in terms of jobs will be felt far from the coal fields. This is illustrated by the projections for 1980 under Alternative I. Notice that 1,250 of the 1,500 primary jobs will be in the three counties. (The exceptions are some railroad workers strung out along the right of ways.) But total derivative employment in the three counties will be only 1,300, compared to a total of 4,000 derivative jobs if the entire seven-county area is considered. The explanation for this is simple: the seven counties contain the trade centers of Billings and Miles City, where much of the derivative impact will be felt. The new mining and processing workers at the coal fields will lead to some new derivative jobs in the nearby towns of Hardin, Colstrip, and Forsyth. But these communities will still remain relatively small and many residents will still do much of their shopping in the big cities. In addition, and perhaps more importantly, the local merchants are themselves supplied by wholesalers and distributors based in Miles City and Billings. Thus, increased economic activity near the coal fields will be quickly transferred to the trade centers.

The projections in table 3 also demonstrate the magnitude of the potential impact of gasification. Looking at the total for the seven counties in 1980, we see that there will be 5,550 primary and derivative jobs under Alternative I and 8,000 under Alternative II. The difference between them is due only to one gasification plant. Similarly, in 1985, we project 6,450 primary and derivative jobs if no gasification plants are built and 11,250 jobs if two plants are in operation. Thus, the potential economic impact on southeastern Montana depends crucially on developments concerned with gasification; and this is the one area, as was discussed earlier, where there is the most uncertainty.

The preceding paragraphs have emphasized the increases in total employment. But there are significant differences between primary and derivative jobs. Perhaps the most obvious dissimilarity is in earnings; on the average, the primary jobs pay much better than the derivative positions. Table 4 summarizes our projections for 1985 and shows that primary workers will earn between $14,300 and $17,600 (1970 dollars) per year while the

Table 4

Projected Average Annual Earnings in Primary and Derivative Jobs Economic Impact Area 1985

(In 1970 Dollars)

	Average Annual Earnings
Primary jobs	
Coal mining	$16,600
Electrical generation	15,700
Gasification	14,300
Railroads	17,600
Derivative jobs[a]	9,500

[a]Based on Alternative II projections for the seven-county impact area.

average derivative worker will earn about $9,500 per year (1970 dollars). There are a number of reasons for this inequality. The derivative sector includes a wide range of occupations, from lawyers, physicians, and other self-employed businessmen, and relatively well-paying government positions, to the lowly clerk in the drug store; and $9,500 per year is an average which covers all these jobs. Also, much of derivative employment consists of part-time workers in the trades and services whose average earnings would undoubtedly be higher if they worked full-time.

The projections in table 3 refer to the number of jobs, not the number of workers. That is, a person may hold more than one job and be counted several times in total employment. Our estimates are prepared in terms of number of jobs so that they will be comparable with the data for 1970 from the Bureau of Economic Analysis, which appear in table 3. Because the numbers represent jobs, they may overestimate the actual number of workers needed to fill the new positions. The propensity to moonlight is difficult to predict; but we believe there will be numerous multiple jobholders, especially in the derivative industries, and have allowed for this in our projections.

Will the Population Mushroom?

In the previous section we saw that coal-related development will lead to increased job opportunities in southeastern Montana. This, in turn, implies an increased population. Table 5 presents our population projections for the three and the seven counties under the assumptions of no coal development and development Alternatives I and II.

Looking first at the seven counties, we see that the population is projected to increase from 123,295 in 1970 to 132,800 in 1985 even if no coal development materialized. Under Alternative I, the population is projected to be 135,150 in 1980 and 143,150 in 1985. Alternative II is associated with even higher levels: 139,700 people in 1980 and 152,550 in 1985. Thus, coal-related development as represented by Alternative I implies a net increase of about 10,000 residents in 1985 (143,150 versus 132,800); Alternative II is associated with a net increase of about 20,000 people during the same period (152,550 versus 132,800).

Equivalent analysis of the three counties is impossible because of the lack of "no development" projections. Comparing the 1985 projections to the actual population in 1970, however, we see that Alternative I implies a population of 25,100, up about 6,000 from 1970, and Alternative II is associated with 30,350 residents, an increase of approximately 11,000 over the 1970 figure.

Simply presenting our projections does not answer the question concerning a mushrooming population. Some people may look at these figures and conclude that a net increase of 20,000 people is a drop in the bucket compared to the size of the area and the base from which it started. On the other hand, others may point out that much of this growth will occur in rural counties with a history of stable, or even declining, populations. Unfortunately, there is no objective standard for defining rapid population growth. The concept of "no net migration" population may help to put things in perspective. Under this concept, the number of people leaving the three- and the seven-county areas is exactly balanced by people moving in, and any population growth is due to an excess of birth over deaths. Thus, no net migration projections represent the potential population levels which are built into characteristics of the 1970 residents.

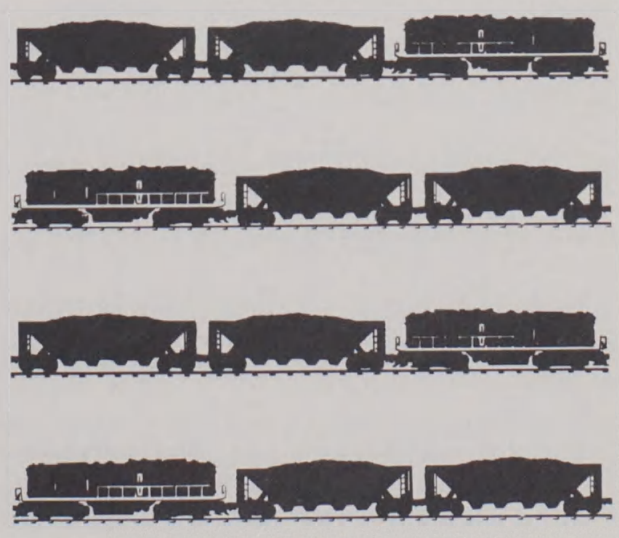


Table 5

Population in the Economic Impact Areas with and without Coal Development 1970 and Projected 1980 and 1985

	1970	Projected 1980	Projected 1985
With no coal development			
Three-county impact area[a]	18,951	NA	NA
Seven-county impact area[b]	123,295	129,600	132,800
With coal development			
Alternative I -- no gasification			
Three-county impact area[a]	18,951	23,650	25,100
Seven-county impact area[b]	123,295	135,150	143,150
Alternative II -- with gasification			
Three-county impact area[a]	18,951	26,150	30,350
Seven-county impact area[b]	123,295	139,700	152,550

Sources: U.S. Department of Commerce, Bureau of the Census, *U.S. Census of Population: 1970, Characteristics of the Population, Montana*, vol. 1, pt. 28 (Washington, D.C.: U.S. Government Printing Office, 1973), table 9, p. 28-12; and U.S. Department of Commerce, Bureau of Economic Analysis, Regional Analysis Projections System, unpublished data (Washington, D.C., 1973). The projections under Alternatives I and II were developed by the University of Montana, Bureau of Business and Economic Research (Missoula, Montana).

NA denotes not available.

[a] Big Horn, Powder River, and Rosebud counties.

[b] Big Horn, Powder River, Rosebud, Custer, Musselshell, Treasure, and Yellowstone counties.

Table 6

Population in the Economic Impact Areas, Assuming No Net Migration 1970 and Projected 1980 and 1985

	1970	Projected 1980	Projected 1985
Three-county impact area[a]	18,951	21,500	23,200
Seven-county impact area[b]	123,295	138,200	147,800

Source: U.S. Department of Commerce, Bureau of the Census, *U.S. Census of Population: 1970, Characteristics of the Population, Montana*, vol. 1, pt. 28 (Washington, D.C.: U.S. Government Printing Office, 1973), table 9, p. 28-12. The projections were developed by the University of Montana, Bureau of Business and Economic Research (Missoula, Montana).

[a]Big Horn, Powder River, and Rosebud counties.

[b]Big Horn, Powder River, Rosebud, Custer, Musselshell, Treasure, and Yellowstone counties.

The no net migration projections for the three and the seven counties are presented in table 6. Comparing these projections with those presented in table 5 puts a somewhat different light on the growth associated with coal development. For example, while the 30,350 residents projected for the three counties under Alternative II during 1985 represents a sizable increase compared to 1970, it is only 7,000 larger than what would have occurred with no migration. (This difference is related to our estimates of net migration, which will be discussed later.) The comparison for the seven counties is even more revealing; only under Alternative II is the projected population associated with coal development larger than the no migration estimate. In other words, the growth due to coal under Alternative I is less than the potential already existing in the area and that associated with Alternative II is only slightly larger than the existing potential.

The reader may have noticed that the projections for employment grow at a faster rate than population. There are two reasons for this. First, there was considerable slack in the economy during 1970. The growth projected for the 1970-80 decade will be partially absorbed by reducing this excess capacity. In particular, many of the new positions may be filled by those currently underemployed or outside the labor force. Secondly, the postwar baby crop will continue to enter the labor force and swell the ranks of potential workers. This may, to some extent, reduce the number of new workers who would otherwise move into the area.

Will the People Be Better Off?

Much of the current controversy about coal development centers on the debate concerning whether or not, all things considered, the benefits outweigh the costs. There have been many claims

made by both sides and we are dismayed at how few are based on actual facts or sound reasonings. The facts are these: given the current state of economic methodology, we are unable to incorporate all aspects and definitively conclude whether or not a change is beneficial. This type of analysis includes much more than simply asking people what they think or how they perceive that future events will affect their well-being. They may be misinformed as to what will happen and/or they may incorrectly assess their reactions to future events. We view with skepticism any report or study which purports to have considered all factors and comes to a general conclusion concerning total benefits and costs. In this study we prefer to deal with only those aspects for which hard evidence can be presented. We know that our data are limited and our approach has many omissions. However, by being cautious we at least ensure that the conclusions, though incomplete, are not based on mere speculation.

Per capita income is one measure of economic welfare. It is not perfect because it equates well-being with money income. Also, per capita income is simply an average for all residents and does not show how the income is distributed among individuals. But it is easily understood and is available for other regions as well so that comparisons may be made. Table 7 presents current and projected levels of per capita for the three and the seven counties under the various development alternatives. During the past several decades, per capita income in both the three and the seven counties has not risen as fast as the national average, so that during 1970 these areas

Table 7

Per Capita Personal Income in the Economic Impact Areas, with and without Coal Development 1970 and Projected 1980 and 1985

	Per Capita Personal Income (In 1970 Dollars)			Percentage of United States		
	1970	Projected 1980	Projected 1985	1970	Projected 1980	Projected 1985
With no coal development						
Three-county impact area[a]	$3,200	$ NA	NA	81	--	--
Seven-county impact area[b]	3,600	4,800	5,600	91	89	91
With coal development						
Alternative I -- no gasification						
Three-county impact area[a]	3,200	4,900	5,600	81	91	91
Seven-county impact area[b]	3,600	5,200	5,850	91	97	95
Alternative II -- with gasification						
Three-county impact area[a]	3,200	5,200	6,100	81	97	99
Seven-county impact area[b]	3,600	5,250	5,950	91	97	96

Sources: U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economics Information System, unpublished data (Washington, D.C., 1973); and *idem*, Regional Analysis Projections System, OBERS Projections, unpublished data (Washington, D.C., November 1973). The projections under Alternatives I and II were developed by the University of Montana, Bureau of Business and Economic Research (Missoula, Montana). Percentages derived.

NA denotes not available.

[a] Big Horn, Powder River, and Rosebud counties.

[b] Big Horn, Powder River, Rosebud, Custer, Musselshell, Treasure, and Yellowstone counties.

stood at only 81 and 91 percent, respectively, of the nationwide figure. Looking at table 7, we see that, in the absence of coal development, per capita income in the seven counties is projected to increase but still remain about 10 percent below the average for the nation. We do not have equivalent projections for the three counties.

Assuming Alternative I, per capita incomes in both the three and the seven counties are projected to increase relative to the national average. In the three counties, per capita income will jump to 91 percent of the nation in 1980 and then will maintain that level in 1985. For the seven counties, the corresponding values are 97 and 95 percent, respectively. The apparent slowing of the growth in both the three and the seven counties between 1980 and 1985 may cause some concern. We should point out that these are rough projections and a 1 or 2 percent difference is not to be taken seriously. Also, Alternative I (which, remember, is only a guess on our part) allocates most of the new coal-related projects to the 1970-1980 period.

Per capita incomes are projected to grow even faster under Alternative II. By 1985, the average for the three counties will be $6,100 (1970 dollars) and for the seven counties it will be $5,950 (1970 dollars), equaling 99 and 96 percent, respectively, of the national average. The three counties will jump slightly ahead of the seven counties because most of the highly paid primary workers will reside near the coal fields.

In summary, coal development will increase the average level of economic well-being as measured by per capita income in southeastern Montana. It will not perform miracles; at best the average income levels will remain below the national projections. But they do represent a significant improvement over historical levels.

Who Will Get the New Jobs?

One of the most frequently voiced concerns is that the new employment positions will be filled by migrants and not by current residents. To be honest, there is very little we can say concerning the degree to which the jobs will be filled by outsiders. The best that we can do is to describe the skill requirements in a very general way and to discuss some of the underlying problems.

Strip mining is more closely related to heavy construction than to underground mining. In fact, several of the mining companies have subcontracted actual operations to construction firms. Thus, the primary occupations would be heavy equipment operation and maintenance. We are not sure of the exact requirements, but certainly some training or apprenticeship is required. Electrical generation and gasification plants are very sophisticated and capital intensive. Other than for a few technical and skilled jobs, however, most of the positions appear to center around routine maintenance and repair. Once again, we are not certain of the exact qualifications, but some of these jobs may be filled after only a relatively short training period, or they may be amenable to on-the-job training.

Even if the companies made a sincere effort to train and hire local people, there will undoubtedly be a significant number of newcomers. The primary jobs are most apt to be filled by working-age males; this is the one category where there is the least oversupply in the region. Most of these men are currently employed and, perhaps, supporting families. They may be reluctant to quit their current jobs and undertake a period of training (with reduced or no income) even if the new position will, in the long run, be better paying. Or, some potential workers simply may not wish to be employed in these kinds of occupations.

The greatest attention will undoubtedly be centered on the well-paying primary jobs. But we should not ignore the derivative jobs, which will far outnumber the jobs of the miners and the electrical and gasification workers. It will be easy to forget these positions because they are not obviously identified with coal development. For example, there may be an additional clerk at the grocery store, a new school teacher, or even an expanded service department at the car dealership. Derivative jobs will, on the average, pay less than the primary jobs, but they often require less training and many are part-time. If historical patterns prevail, many of these jobs will go to young people and to women, who appear to suffer dis-

Table 8

Residence in 1965 of the 1970 Resident Population of the Economic Impact Area Counties

	Big Horn	Powder River	Rosebud	Custer	Musselshell	Treasure	Yellowstone
Total resident population five years old and over in 1970	8,955	2,588	5,424	11,258	3,461	837	80,297
Residence in 1965							
Different county	1,528	710	1,474	2,397	521	105	18,481
Percentage of total	*17.1*	*27.4*	*27.2*	*21.3*	*15.1*	*12.5*	*23.0*
Different state	643	449	753	953	184	9	9,610
Percentage of total	*7.2*	*17.3*	*13.9*	*8.5*	*5.3*	*1.1*	*12.0*

Source: U.S. Department of Commerce, Bureau of the Census, *U.S. Census of Population: 1970, Characteristics of the Population, Montana*, vol. 1, pt. 28 (Washington, D.C.: U.S. Government Printing Office, 1973), table 119, pp. 28-196 to 28-200.

proportionately from real and disguised unemployment in this area.

Will Coal Development Benefit Current Residents?

A current view argues that economic development is desirable only if it benefits the current residents of an area. On the surface, this appears to be a desirable criterion. However, in our mobile and ever-changing society, it is difficult to determine exactly who are the current residents. This is particularly true in our case where we are dealing with events five to ten years in the future. Specifically, who are the current residents in 1985? They will certainly be different from those in 1970, and what is beneficial for the latter may not be beneficial for the former.

Rural Montana counties have, in general, experienced stable or declining populations. This does not mean they are static and unchanging. Table 8 examines the 1970 population of the seven counties according to its place of residence in 1965. In Big Horn, Powder River, and Rosebud counties, between 17 and 27 percent of the 1970 residents over five years of age lived in a different county during 1965. Further, between 7 and 17 percent were from a different state. In other words, in only five years, about one-fifth to one-fourth of the 1970 population in these three rural counties were newcomers. Thus, if this trend continues, the concept of current residents becomes meaningless.[20]

Will Coal Development Lead to an Influx of Newcomers?

Unfortunately, we are unable to precisely answer this question. Current research procedures cannot reliably predict the movement of people between regions. The best that can be done is to analyze net migration, the difference between the number of people leaving and those moving into an area. Current and projected figures for net migration in the three and the seven counties are presented in table 9.

If no coal development takes place, the historical trend in the seven counties will continue, and significant net outmigration will take place. Between 1960 and 1970, 8,182 more people left than

[20]These findings do not appear to be unique for this area. Between 15 and 25 percent of the 1970 population of most Montana counties were newcomers since 1965. Further, a similar pattern, which differs only slightly for individual counties, is exhibited by 1955-1960 data.

Table 9

Net Migrants in the Economic Impact Areas, with and without Coal Development 1960-1970 and Projected 1970-1980 and 1980-1985

	1960-1970	Projected 1970-1980	Projected 1980-1985
With no coal development			
Three-county impact area[a]	-2,528	NA	NA
Seven-county impact area[b]	-8,182	-8,100	-5,300
With coal development			
Alternative I -- no gasification			
Three-county impact area[a]	-2,528	2,100	- 600
Seven-county impact area[b]	-8,182	-2,700	-1,200
Alternative II -- with gasification			
Three-county impact area[a]	-2,528	4,500	1,800
Seven-county impact area[b]	-8,182	1,800	3,100

Sources: U.S. Department of Commerce, Bureau of Economic Analysis, Regional Analysis Projections System, OBERS Projections, unpublished data (Washington, D.C., 1973); and U.S. Department of Commerce, Bureau of the Census, *U.S. Census of Population and Housing: 1970, General Demographic Trends for Metropolitan Areas, 1960 to 1970, Montana,* PHC(2)-28 (Washington, D.C.: U.S. Government Printing Office, 1971), table 3, pp. 28-10 and 28-11. The projections under Alternatives I and II were developed by the University of Montana, Bureau of Business and Economic Research (Missoula, Montana).

Note: A negative figure denotes net outmigration from the area.

NA denotes not available.

[a] Big Horn, Powder River, and Rosebud counties.

[b] Big Horn, Powder River, Rosebud, Custer, Musselshell, Treasure, and Yellowstone counties.

moved into this area. We project that between 1970 and 1980 there would be about 8,100 net outmigrants. Then, between 1980 and 1985, there would be an additional 5,300 net outmigrants. We could not make a projection for the three counties assuming no coal development.

Under Alternative I, net outmigration from the seven counties will continue, but at a much reduced rate. Between 1970 and 1980, the number of net outmigrants drops to approximately 2,700 and then to 1,200 during the following five years. In the three counties the historical trend will be reversed during the seventies when there will be about 2,100 net inmigrants, as compared to 2,528 net outmigrants between 1960 and 1970. But the 1980-1985 period will, once again, have those leaving outnumbering new entrants by 600.

Net inmigration is projected for all periods in both the three and the seven counties under Alternative II. There will be approximately 1,800 net inmigrants to the seven counties during the seventies, with about 3,100 following during the next five years.[21] In the three counties, we project net inmigration to be 4,500 between 1970 and 1980 and 1,800 between 1980 and 1985.

As we mentioned earlier, these projections of the net migration do not reflect the number of new people who will move into the area. If anything, they are probably representative of a lower limit. In the past, young people have accounted for a disproportionate share of the net out-migration. The increased employment opportunities associated with coal development may enable many of them to remain. However, this group is notoriously mobile, and many may migrate for reasons unrelated to jobs and earnings. If this occurs, it would require correspondingly more newcomers to replace those leaving.

The possibility of the area being overrun by outsiders from different backgrounds and with different attitudes has repeatedly been expressed with respect to coal development. This fear is undoubtedly very real. However, we think it is somewhat overdramatized and doubt whether some of the dire predictions will materialize. We live in a very mobile society and, as shown previously, there was a 12 to 27 percent turnover in these counties during one five-year period. Thus, while we don't downgrade the serious problems that will have to be faced, we believe this region has demonstrated the ability to adjust to and to accommodate significant numbers of new residents.

Does Coal Development Lead to a "Boom or Bust" Economy?

This question is ambiguous and difficult to answer. One interpretation refers to the cyclical sensitivity of the economy. In other words, would the economy become more prone to the ups and downs associated with the national business cycle? The apparent cause of this concern is the strong cyclical pattern shown by the coal mines in the eastern United States. Steel mills and other industrial firms are among the major buyers of this coal, and when they experience short-run increases or decreases in demand it is quickly passed along to their suppliers, including the eastern coal mines. This will probably not be the case in Montana. The coal for export outside Montana is primarily sold on the basis of long-term contracts to utility companies, which are not overly sensitive to the business cycle. It is possible for the exact delivery dates to be changed within the life of the contract, but we doubt whether this would lead to significant short-run vacillations. Similarly, the output of electrical generation and gasification plants will be committed far in advance and will be affected only remotely by the ups and downs of the nation's economy.

There are instances, however, when it may appear that the local economy is subject to extreme swings. This may occur when the mining and processing installations first begin operation.

[21]The reader may have noticed that the no-migration population projection for the seven counties during 1980 was greater than that for Alternative I. (See tables 5 and 6) Yet, we project net inmigration for this period. The reason for this apparent discrepancy is due to timing of the projects. We believe that most of the new employment opportunities will not materialize until the latter part of the decade. Thus, the 1970-1975 period will probably see continued outmigration with the situation reversed during the next five years. If this occurs, our method projects that the latter will be larger than the former, leading to net inmigration for the decade as a whole.

Table 10

Estimated Peak Construction Employment and Permanent Employment for a Representative Coal Mine, Electrical Generation Plant and Gasification Plant

Facility	Peak Construction Employment	Average Permanent Employment
Coal surface mine (10 million tons per year)	250	220
Electrical generation plant (500 megawatts)[a]	625[c]	43
Gasification plant (250 million scfd)[b]	3,070	625

Source: Developed based on unpublished base data from the Bureau of Business and Economic Research and other sources.

[a] Excluding construction of an associated coal mine.

[b] Excluding construction of an associated coal mine; scfd denotes standard cubic feet per day.

[c] Estimated average annual employment.

In each case, the peak construction employment is greater than the permanent work force required for operation. This is particularly true, as shown in table 10, for electrical generation and gasification plants, where the peak construction employment is many times larger than the number of permanent jobs. Also, the construction periods extend over several years and the number of workers will vary over the life of the project. These ups and downs will not be a permanent feature of the economy. Once the facilities are in operation, they will provide a relatively stable and noncyclical source of employment.

What Will be the Effect of Construction Activity?

Except for its duration, the economic impact of construction will be very much like the impact created by coal-related activity. That is, construction workers represent primary employment and their spending in the local area will create derivative jobs. But we believe that, for a number of reasons, the economic impact per job (the number of derivative workers per primary worker) will be less for construction workers than for permanent employees.

We have chosen to analyze the economic impact of construction separately from the operation of the coal mines and processing facilities. In most cases, this approach reduces confusion and helps to clarify the issues. However, it also tends to create artificial distinctions where there really are none. This is particularly true for the transition period between the construction and operation of a facility. All of the derivative jobs may not suddenly disappear when construction ends and new derivative jobs appear as a result of the permanent primary workers. Rather, the construction and operation periods will probably blend together so that some of the derivative jobs created as a result of construction may continue to exist and be supported by the spending and respending of the permanent employees. Indeed, some construction workers may remain as permanent employees in the new facilities. Mining jobs in particular may appeal to some construction workers.

Because of the number of specific assumptions which would have to be made, we have chosen not to make projections for particular years. At this time we have no sound basis for assuming when additional construction may be undertaken. So, we have put together construction profiles for a representative surface mine, electrical generation plant, and gasification plant. A word of caution as to how these figures relate to our projections for 1980 and 1985 seems appropriate. The employment and population associated with construction cannot simply be added to our earlier projections to derive the "total" impact because this would imply that certain facilities are simultaneously under construction and in full operation.

The construction profiles presented in table 11 must be interpreted with extreme caution. The actual impact of a specific construction project depends critically on the other activity which may be underway at the same time in the area. This is especially true of the population figures shown in table 11, which are simply our estimates of the number of people associated with the primary and derivative jobs created by construction activity. If no other large projects are underway, some of the jobs may be filled by current residents, and these figures then probably overestimated the number of newcomers. On the other hand, if several projects coincide or if the operation of other facilities has already squeezed the local labor market, most of the jobs may be filled by outsiders.

A quick glance at table 11 reveals that coal mines, electrical generation, and gasification plants differ significantly in terms of the duration and impact of the construction period. A ten million ton surface mine can be built in less than two years and may lead to, at most, 250 primary jobs and 330 derivative jobs (most of this activity is related to the assembly of the dragline and loading facilities for the railroad cars). On the other hand, the enormous size of gasification plants is again revealed by the fact that they require nearly four years to build and are associated with up to 2,190 construction workers and 2,870 new derivative jobs.

The magnitude of the impact for construction activity, expecially those for gasification plants on the sparsely populated impact area, may create a specter of massive, short-term economic disruptions. We do not discount this possibility. Surely, large-scale construction projects can create difficulties for small communities. However, we must reemphasize that the impacts shown in table 11, especially the population estimates, probably represent the upper bounds of the actual changes. Also, we believe the gasification plants, which involve the longest construction period and greatest number of workers, are the most uncertain. Finally, all of the changes will not be concentrated in a small area because much of the economic impact, especially the derivative jobs, will be dispersed throughout the seven counties.

How Will Coal-Related Development Affect Agriculture?

There are two ways in which coal development, especially surface mining, will affect agriculture. First of all, strip mining will, at least temporarily, remove some agricultural land from production. Second, the productivity of adjacent land may be affected due to a reduced supply of groundwater or because of air pollution from electrical

Table 11

Employment and Population Associated with Construction of a Representative Coal Mine, Electrical Generation Plant and Gasification Plant

	Construction Period			
	Year 1	Year 2	Year 3	Year 4[a]
Coal surface mine (10 million tons per year)				
Average annual employment				
Primary industries (construction)	150	250		
Derivative industries				
Three-county impact area[b]	80	130		
Seven-county impact area[c]	200	330		
Population				
Three-county impact area[b]	450	750		
Seven-county impact area[c]	700	1,150		
Electrical generation plant (500 megawatts)[d]				
Average annual employment				
Primary industries (construction)	470	940	470	
Derivative industries				
Three-county impact area[b]	240	490	240	
Seven-county impact area[c]	620	1,230	620	
Population				
Three-county impact area[b]	1,450	2,850	1,450	
Seven-county impact area[c]	2,200	4,350	2,200	
Gasification plant (250 million scfd)[e]				
Average annual employment				
Primary industries (construction)	840	2,190	2,040	315
Derivative industries				
Three-county impact area[b]	440	1,140	1,060	160
Seven-county impact area[c]	1,100	2,870	2,680	400
Population				
Three-county impact area[b]	2,550	6,650	6,200	950
Seven-county impact area[c]	3,900	10,100	9,450	1,450

[a]Six months actual working time.

[b]Big Horn, Powder River, and Rosebud counties.

[c]Big Horn, Powder River, Rosebud, Custer, Musselshell, Treasure, and Yellowstone counties.

[d]Excludes construction of an associated coal mine.

[e]Excludes construction of an associated coal mine; scfd denotes standard cubic feet per day.

generation and gasification plants. Both of these potential impacts will have a detrimental effect on gross farm receipts and the earnings of local farmers and ranchers. This, in turn, will have a negative impact on the local economy. Our projections of coal-related development, presented earlier, have taken account of the reductions in agriculture and represent the net effect on the three and the seven counties.

The most crucial determinant of the actual effect on local agriculture is the ability of the coal companies to reclaim the land after surface mining. There are many claims and counterclaims about their ability to do so, which we are unable to evaluate. Consequently, we have assumed the worst possible outcome: that none of the land mined after 1970, when operations began in earnest, will be reclaimed. Table 12 reports that under Alternative I (no gasification) there will be a cumulative total of 5,300 acres disturbed by 1980 and 11,400 acres by 1985. Alternative II (with gasification) is associated with a total of 5,480 acres by 1980 and 12,700 acres by 1985. These figures are based on the average thickness of coal seams in the area, which determine the number of tons beneath an acre of land, and may vary depending on which sites are mined. Also, we have not explicitly considered the farm land removed from production due to new roads, railroad right of ways, coal conversion facilities, or town sites. However, we believe the total for these uses will be small relative to the number of acres disturbed by surface mining. To put things in perspective, the average ranch in the three counties was about 5,800 acres during 1969. Thus, disturbing 12,700 acres (by 1985, under Alternative II) corresponds to the elimination of a little more than two average ranches. This is, of course, somewhat of a simplification because the mined land will be spread over a large area and may include parts of several ranches.

We have assumed that the agricultural productivity of mined land averages $30 per acre (1970 dollars). This compares to actual gross farm receipts from the sale of crops and livestock of about $6 to $7 per average acre in 1970 for all agricultural land in the three counties. We used the $30 figure to allow for the possibility that the most productive land may be taken out of production and/or the productivity of adjacent acreage

Table 12

Impact of Coal Mining on Agriculture in the Economic Impact Area under Alternative Levels of Coal Development 1980 and 1985

	Alternative I (No Gasification)		Alternative II (With Gasification)	
	1980	1985	1980	1985
Acres disturbed (cumulative from 1970)	5,300	11,400	5,480	12,700
Change in gross farm receipts per year (in 1970 dollars)	-$159,000	-$342,000	-$164,400	-$381,000
Change in farm earnings per year (in 1970 dollars)[a]	-$ 95,400	-$205,200	-$ 98,600	-$228,600

Note: These data relate to the impact on farms and ranches in Big Horn, Powder River, and Rosebud counties (three-county impact area).

[a]Farm proprietors' income plus wages and salaries of hired workers.

may also be reduced. For example, it has been alleged that many of the coal fields lie directly under rich and productive bottom land. Thus, using the average for all agricultural land in the three-county area would underestimate the true impact. Also, the mining of coal may lower the water table and reduce the flow in nearby stock and irrigation wells. Current data are very sketchy, but it appears that wells within one-quarter mile or so of the mine will be affected or those directly downhill from the cut may completely dry up.

Based on these assumptions, table 12 reports that Alternative I (no gasification) is associated with a decline of gross farm receipts of $159,000 (1970 dollars) per year in 1980 and $342,000 (1970 dollars) per year in 1985. Farm earnings (proprietor's income of farm and ranch owners plus wages and salaries of hired workers) will decrease by $95,400 (1970 dollars), and $205,200 (1970 dollars) per year in 1980 and 1985, respectively. Under Alternative II (with gasification), gross farm receipts are projected to decline by $164,400 (1970 dollars) per year in 1980 and $381,000 (1970 dollars) per year in 1985; farm earnings will decline by $98,600 (1970 dollars) and $228,600 (1970 dollars) per year in 1980 and 1985, respectively. In comparison, gross farm receipts totaled about $41 million and farm earnings were approximately $21 million in the three counties during 1970. Thus, the potential losses represent, at most, about a one percent decline on an annual basis. We did not estimate the decline in agricultural employment because it depends on the distribution of the land which is disturbed by mining—that is, whether or not entire ranches are taken out of production.

How Will Coal-Related Development Affect Water Use?

Coal-related development may affect water use in two ways: surface mining of coal may impair the quantity or quality of groundwater in wells and springs adjacent to the mine; and electrical generation and gasification plants would consume significant quantities of water, which would be in addition to the extensive current use of water by agriculture.

There are very little current data concerning the impact of surface mining on the availability of groundwater. Each case is different and must be analyzed individually. In the one area for which there are data, wells within one and one-half miles of the mine have experienced some drops in water level. But only those immediately adjacent (less than one-quarter mile) to the mine may become nonproductive. After mining has ceased, there is some evidence that groundwater levels may increase, but water quality may be impaired by its seeping through the spoilbanks.

Table 13 presents our projections of the increase in water demand associated with Alternatives I and II. These figures include the use of water by electrical generation and gasification plants and the increase in domestic demand due to the projected growth in population associated with coal-related development. Under Alternative I, we project that total water use will increase by 38,470 acre-feet per year in 1980 and then grow to 57,670 by 1985. The addition of gasification and the increased population associated with it in Alternative II results in projected water use of 49,610 and 80,020 acre-feet per year in 1980 and 1985, respectively.

Table 13

Projected Additional Water Demand, by Kind of Use under Alternative Levels of Coal Development Seven-County Impact Area 1980 and 1985

(In Acre-Feet per Year)

	Alternative I (No Gasification)		Alternative II (With Gasification)	
	1980	1985	1980	1985
Electrical generation	37,080	55,080	37,080	55,080
Gasification	0	0	10,000	20,000
Domestic use[a]	1,390	2,590	2,530	4,940
Total	38,470	57,670	49,610	80,020

Note: The seven-county impact area includes Big Horn, Powder River, Rosebud, Custer, Musselshell, Treasure, and Yellowstone counties.

[a]Based on the population attributed to coal-related development presented in table 3.7, of our original study.

We believe that, in the aggregate, there are sufficient potential additional sources of water to satisfy the projected demand. However, there will probably have to be some investments in new reservoir capacity to capture increased portions of the annual runoff. In many cases, aqueducts may have to be built to transport the water to coal-processing sites. The Montana Power Company has received approval to divert about 14,000 acre-feet per year from the Yellowstone River to cool Colstrip I and II. It will be transported about thirty miles from the riverbed via pipeline. A second pipeline has been proposed to service plants III and IV. There are a number of potential sites for new dams, as well as proposals for expanding existing reservoirs; these are summarized in table 14. We do not know which, if any, of these sites will be developed nor the routes which the aqueducts will follow. This will depend on the precise location of the new electrical generation and gasification plants, an aspect which we have repeatedly refused to project.

Table 14

Potential Dams and Reservoirs in the Economic Impact Area

River/Site	Potential Annual Water-Supply [a] (Acre-Feet)
Big Horn River	
Little Big Horn Reservoir	40,000
Powder River	
Moorhead Reservoir [b]	57,000
Tongue River	
Tongue River Reservoir [b]	60,000
Yellowstone River--total [c]	1,356,000
Allenspur Reservoir	
Buffalo Creek Reservoir	
Cedar Ridge Reservoir	
Sunday Creek	

Source: U.S. Department of the Interior, Bureau of Reclamation, *Appraisal Report on Montana-Wyoming Aqueducts* (Billings, Montana, April 1972), p. 9.

Note: An acre-foot of water represents 43,560 cubic feet or 325,900 gallons.

[a] Available to Montana.

[b] Additional capacity.

[c] Available from the main stem of the Yellowstone River by offstream reservoirs or Allenspur Dam.

Table 15

Current (1969) and Potential Irrigated Land in the Economic Impact Area, by County

(In Acres)

	Currently Irrigated Land	Potentially Irrigable Land [a]
Big Horn	48,400	16,115
Powder River	13,215	42,865
Rosebud	34,993	26,530
Subtotal	96,608	85,510
Custer	28,658	40,715
Treasure	16,209	6,020
Yellowstone	80,772	2,000
Total	222,247	134,245

Sources: U.S. Department of Commerce, Bureau of the Census, *Census of Agriculture: 1969, Area Reports, Montana*, vol. 1, pt. 38, sec. 2 (Washington, D.C.: U.S. Government Printing Office, 1972), table 11, pp. 20, 76, 308, 356, 420, and 452; and U.S. Department of the Interior, Bureau of Reclamation, *Report on Resources of Eastern Montana Basins* (Billings, Montana, August 1972), p. 43, derived.

Note: These counties depend on the Big Horn, Powder River, Tongue, and Yellowstone Rivers in the economic impact area for their agricultural water; Musselshell County, the seventh county in the seven-county impact area, is excluded because it depends on a different source.

[a] In addition to land currently irrigated.

It has been suggested that increases in the supply of water be used in agriculture rather than for the processing of coal. Table 15 shows that there is a significant potential for the expansion of irrigated acreage, especially in Powder River and Rosebud counties. However, we are unable to assess whether or not irrigating this land is economically feasible. This classification was based only on the ability of the soil to produce good yields of adapted crops if furnished with sufficient water. The source of water and engineering costs were not considered. These costs are probably quite high and may be the principal reason this land is not currently under irrigation.

In summary, we believe that coal-related development at the projected levels will not be hindered by the availability of water. There appear to be sufficient quantities of water to satisfy these needs, providing that the required reservoirs and aqueducts are built, without endangering the existing supplies to agriculture and other water users.

Table 16

Estimated Strippable Coal Reserves and Affected Land Area Three-County Impact Area and Montana

	Strippable Coal Reserves (Millions of Tons)	Affected Land Area	
		Acres	Percentage of Agricultural Land
Three-county impact area	34,216	762,063	*10.2*
Big Horn	10,254	219,792	*7.8*
Powder River	16,186	386,623	*22.8*
Rosebud	7,777	155,648	*5.3*
Montana	42,562	1,152,640	*1.8*

Sources: Robert E. Matson, "Strippable Subbituminous and Lignite Coal Fields, Eastern Montana," mimeographed (Butte, Montana: Montana Bureau of Mines and Geology, 1973), table 1. Percentages derived, based on data from U.S. Department of Commerce, Bureau of the Census, *Census of Agriculture: 1969, Area Reports, Montana*, vol. 1, pt. 38, sec. 2 (Washington, D.C.: U.S. Government Printing Office, 1972), table 1, pp. 1, 17, 305, and 353.

Note: Detail may not add to totals because of rounding.

What Will Happen when the Coal Runs Out?

This is a question which, on the surface, can be easily answered. However, there are further implications which require careful consideration. The superficial answer is found in table 16, which reports there are 34,216,000,000 tons of strippable coal in the three-county area. Even at rates of extraction far exceeding our maximum projections the reserves in this small area would last for hundreds of years. These deposits lie under some 762,063 acres of land, representing roughly 10 percent of the total agricultural land in the three counties. Thus, for all practical purposes, we are not going to run out of coal.

The real underlying issue concerns the long-run viability of coal-related development. It is important to remember that, as we mentioned in the first section, the three uses of Montana coal (for export, electrical generation, and gasification) are relatively independent, and the long-run prospects for one may not apply to the others.

Much of the current demand for Montana coal for export is due to the Midwestern utilities' attempts to comply with sulfur emission standards. If present research is successful, sulfur scrubbers may become operational and these companies may, once again, rely on closer sources of coal. This would significantly decrease the demand for Montana coal. On the other hand, there may be developments in the other coal-producing regions, such as stringent environmental controls,

which may increase their costs of production so that Montana coal, even though it must be transported further, may have a cost advantage.

Even in the very unlikely case that the demand for Montana's coal for export drops to zero, the vision of ghost towns covering the landscape is an overdramatization. This coal has been sold under long-term contracts with expiration dates spread over the next decades. Thus, the decreases in mining employment would be dispersed over many years. The adjustment of an area to employment declines is, of course, painful. However, this area has shown the ability to adjust to equivalent changes in the recent past. We have projected that there will be about 800 Montana residents directly employed in extracting coal for export in 1985. This is far fewer than the approximately 1,400 agricultural jobs which were lost in the three counties between 1950 and 1970.

There has been widespread use of the amortization period of the projected facilities, usually twenty or thirty years, as an estimate of the lifetime of coal-related development in eastern Montana. This interpretation is, at best, misleading and, at worst, outright deception. Amortization is an accounting concept and should not be confused with the long-run viability of coal-related development. A firm will close if the demand for its product decreases sufficiently even if its fixed capital has not yet been amortized. Conversely, if the demand for output grows or advanced technology is developed, new plant and/or equipment may be added regardless of whether the old facilities were amortized.

The long-run future of electrical generation and gasification is, as we have said so often, full of uncertainties. However, if these facilities are built, they are less likely to be abandoned than are export mines. We are skeptical of the national energy projections which suggest mammoth increases in capacity if future demands are to be met. But we doubt that the projections are so inaccurate that rising demands will not be sufficient to absorb the output of a moderate number of new facilities. The large capital investment required for electrical generation and gasification plants suggests that owners will have a long horizon and will not close down on the basis of short-run vacillations. Also, the huge sums involved will probably make investors more cautious so that if they proceed, it will be on the basis of sound evidence that there will be sufficient demand to justify the increased capacity.

In short, there are no iron-clad guarantees concerning the long-run viability of coal-related development. The demand for Montana coal and power may decline someday, but not all at once; indeed the risk of a coal bust may be no greater than the chance of a precipitous decline in tourism, dependent as it is upon the uncertainties and increasingly expensive sources of fuel. Very few industrial developments carry with them assurances of long-term permanence.

Will Coal Development Pay for Itself in Additional Tax Revenue?

This is, perhaps, one of the most asked questions concerning coal-related development. Unfortunately, we do not have an unqualified answer. Our projections are not well suited for analyzing the changes in taxes and expenditures. In the first place, specific sites for the new mines, electrical generation, and gasification plants, and the spatial distribution of the increased population have not been projected. This prohibits estimating the taxes and expenditures of certain local government units, such as municipalities. Also, our projections do not allow for inflation; they are in terms of constant 1970 dollars. Some of the most important taxes, i.e., the Montana income tax, use graduated rates and their revenue is affected by inflation. We have, however, prepared rough estimates—we call them "ballpark" figures—of increases in certain expenditures and revenues of selected taxes associated with coal-related development. The speculative nature of these projections cannot be over-emphasized; the revenues from several tax sources and expenditures by local governments have been omitted. But, if these reservations are kept in mind, these projections do give a rough picture of some of the relevant magnitudes.

Table 17 presents the projections of increased revenue from selected taxes to the three counties, seven counties, and the state of Montana. The revenue accruing to the counties is based only on countywide levies and excludes the taxes due to local governments. The estimates for the state of Montana do not include the corporation license tax. Under Alternative I, the three counties are projected to receive $16,102,000 (1970 dollars) in tax revenue from coal activities during 1980. The entire seven-county area will receive $16,174,000 (1970 dollars). The $72,000 difference is due only to the taxable property associated with increased population residing outside the three counties; for example, in Miles City or Billings. The state of Montana is projected to receive $21,201,000 (1970 dollars). In 1985, tax revenues in the three and the seven counties will grow by $22,505,000 and $22,857,000 respectively, and the revenue to the state government will increase by $27,307,000, with all figures in constant 1970 dollars. If gasification materializes, there will be significant increases in revenue. We project that in 1980, the three and the seven counties will receive $22,099,000 and $23,343,000 from coal activities, while $24,948,000 will accrue to the state of Montana. By 1985, these figures will increase to $35,175,000, $35,875,000, and $35,083,000 for the three counties, the seven counties, and state government. Again, all figures are in 1970 dollars.

Projections of new school construction and operating costs in the three counties are shown in table 18. As with all our figures in this section, they must be interpreted with extreme caution. They were based only on the projected net increases in enrollment in the three counties due to coal-related development. The actual increases may be larger in affected schools, with offsetting declines in districts far from the development area. Also, we have not surveyed the capacity of existing schools

Table 17

Projected Partial Tax Revenues from Coal-related Activities under Alternative Levels of Coal Development 1980 and 1985

(In 1970 Dollars)

	Alternative I (No Gasification)		Alternative II (With Gasification)	
	1980	1985	1980	1985
Three-county impact area[a]	$16,102,000	$22,505,000	$22,099,000	$35,175,000
Seven-county impact area[b]	16,174,000	22,857,000	22,343,000	35,875,000
State of Montana[c]	21,201,000	27,307,000	24,948,000	35,083,000

Note: Excluded from the projections are the Montana corporation license (income) taxes paid and taxes paid to municipalities and other local governments.

[a]Big Horn, Powder River, and Rosebud counties.

[b]Big Horn, Powder River, Rosebud, Custer, Musselshell, Treasure, and Yellowstone counties.

[c]Includes only those tax revenues paid to the State of Montana.

Table 18

Projected New School Construction and Additional Operating Expenditures under Alternative Levels of Coal Development Three-County Impact Area 1980 and 1985

(In 1970 Dollars)

	Alternative I (No Gasification)		Alternative II (With Gasification)	
	1980	1985	1980	1985
Construction costs	$1,452,000	$1,960,200	$2,999,700	$5,372,400
Annual operating costs	308,000	415,800	636,300	1,139,600

Notes: The three-county impact area includes Big Horn, Powder River, and Rosebud counties. The projected amounts of construction and operating costs are all calculated as the projected change from 1970.

Table 19

Projected Additional Government Expenditures under Alternative Levels of Coal Development Economic Impact Areas and Montana 1980 and 1985

(In 1970 Dollars)

	Alternative I (No Gasification)		Alternative II (With Gasification)	
	1980	1985	1980	1985
Three-county impact area[a]	$ 352,000	$ 461,000	$ 540,000	$ 855,000
Seven-county impact area[b]	416,000	776,000	758,000	1,481,000
State of Montana	1,665,000	3,105,000	3,030,000	5,925,000

Notes: The projected additional government expenditures in the three- and seven-county impact areas pertain to county governments only; they exclude expenditures of the school districts, municipalities, and other local governments in the two impact areas. Also, these data relate to total direct general expenditures.

[a]Big Horn, Powder River, and Rosebud counties. The projected additional expenditures for this impact area are based on the projected population change from 1970.

[b]Big Horn, Powder River, Rosebud, Custer, Musselshell, Treasure, and Yellowstone counties.

to see if they could accommodate the new students. Rather, the school construction costs reflect the assumption that the net increase in enrollment would require new facilities. Under Alternative I, we project that the increased enrollments due to coal-related development will require additional expenditures of $1,452,000 (1970 dollars) by 1980 and will total $1,960,200 (1970 dollars) by 1985. The additional operating costs are projected to be $308,000 per year in 1980 and $415,800 per year in 1985, both in terms of 1970 dollars. Assuming Alternative II, the costs of new construction will be almost $3,000,000 in 1980 and $5,372,400 in 1985, while operating costs are projected to grow by $636,300 and $1,139,600 per year, respectively, with all figures in 1970 dollars.

We have not inventoried existing facilities of state and county governments and have made no estimates of the new construction which would be required by the increased population associated with coal-related development. We did, however, make rough estimates shown in table 19, of the increase in operating expenditures by county governments (excluding municipalities and other local government units) and the state of Montana. County expenditures refer to activities such as highway maintenance and law enforcement, while state expenditures would be for items like the university system, public assistance, and institutions. Assuming Alternative I, expenditures would rise by $352,000 (1970 dollars) and $416,000 (1970 dollars) per year in the three and the seven counties, respectively, by 1980. Once again, the difference between these figures is due to the increases in population residing outside the three-county area. During 1985, expenditures will have increased by $461,000 (1970 dollars) per year in the three counties and $776,000 (1970 dollars) in the seven counties. We project the increase in expenditures by state government to be $1,665,000 (1970 dollars) per year in 1980 and $3,105,000 (1970 dollars) during 1985. Under Alternative II, expenditures in the three-county area will increase by $540,000 (1970 dollars) per year in 1980 and $855,000 (1970 dollars) per year in 1985. The corresponding figures for the seven counties are $758,000 (1970 dollars) and $1,481,000 (1970 dollars) per year, respectively. Expenditures of the state of Montana are projected to increase by $3,030,000 (1970 dollars) per year in 1980 and $5,925,000 (1970 dollars) per year in 1985.

We are extremely hesitant to use our projections to conclude whether or not increased tax revenue will exceed the growth in expenditures. We have not estimated the revenue from the Montana corporation license tax and the property tax revenues and operating expenditures of cities and special districts as well as the capital expenditures of state and local governments. Further studies are needed to plug these holes so that a thorough tax and expenditure analysis can be done. Even if total revenue is greater than total expenditures, this does not mean there will be no problems. Most of the taxes can be collected only after the mines and generating facilities are in operation. But increased expenditures may have to be made earlier, i.e., during the construction period.

Comparing total tax revenue to total expenditures may paint too rosy a picture because the taxing units may not be the same as those making the expenditures. Most of the tax revenue to county government is derived from the property tax on the electrical generation and gasification plants and the net proceeds tax on coal mines, and will go to the three counties. However, much of the population growth and increases in expenditures may be in Miles City and Billings, which will not have significant increases in their tax base. The same problem may also occur in smaller units; school districts with an increase in their taxable property due to, for example, a new generating plant, may not be the ones with increased enrollment.

The dispersion of the economic impact and the increased population throughout the seven counties may also have some benefits. We anticipate that much of the growth will be in existing towns and cities, which already may have fire and police departments, sewers, and other social services. In the long run, it may be more economical to expand these existing facilities than to start from scratch with "new towns."

Our Changing Philosophy of Land Use

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We need a philosophy that can rationalize laws which will protect private ownership without hamstringing the legitimate public interest.
John Cribbet, in the *Iowa Law Review*

The job of a philosopher is to make explicit the conceptual and value structures which underlie and inform the beliefs of people at particular times and places, to determine if these structures are inconsistent or otherwise deficient, and, if necessary, to propose new, hopefully more adequate, concepts and values. His perspective is necessarily very general, and somewhat abstract, as he tries to gain a view of the whole.

"Private rights," "public interest," and "development" are the concepts which traditionally have been crucial in thinking about land-use policy. Each has associated with it a different constellation of values. The first two concepts particularly find concrete embodiment and definition in the law.[1] In these notes, we want to focus on the concepts of private rights and public interest, although what we say should eventually have some implications for the concept of development as well.

Traditional Concepts and Values

To become clearer about these concepts, it is first necessary to trace their ancestry. Public interest is, in fact, the older concept. We need go back no further, however, than feudal times, when this concept (or something like it) was used to restrain landowners in various ways. R. H. Tawney, in his classic *Religion and the Rise of Capitalism* (1926), puts the feudal view as follows:

> Property was not merely a source of income, but a public function, and its use was limited by social obligations and necessities of state . . . . The owner is a trustee, whose rights are derived from the function which he performs and should lapse if he repudiates it.

Which is to say that on this view, to state it very briefly, landownership involves as many responsibilities and duties as it does economic privileges (although the concept of the public interest, including as it did the notion of obligations owed to a feudal lord, was in many ways very different from our own).

For a variety of economic, social, and political reasons—all connected with the overthrow of the feudal order, the development of democratic forms of government, and the emergence of the commercial classes—this view of property was gradually superseded in the sixteenth and seventeenth centuries as the concept of private rights began to replace the concept of public interest in determining land-use policy. The new view of property received its classic formulation in the writings of the seventeenth century English philosopher John Locke.[2] By the eighteenth century, when American institutions were formed, no one seriously questioned it.

The feudal concept of landowner as trustee gave way to the concept of landowner as absolute master by the eighteenth century

According to Locke, the right to property was a natural and inalienable right, *prior to* the existence of government and law. The purpose of government and law, in fact, was in large part merely to guarantee and defend this right. As Locke put it, "the supreme power [i.e., the state] cannot take from any man or any part of his property without his own consent." On this view of property (again to quote Tawney),

> . . . the individual is absolute master of his own, and, within the limits set by positive law, may exploit it with a single eye to his pecuniary advantage, unrestrained by any obligation to postpone his own profit to the well-being of his neighbors, or to give account of his actions to a higher authority.

The owner of a fee simple title has, in a phrase of Blackstone's that was to become standard in law, "sole and despotic dominion" over his land.

It was an important part of this new (and in the circumstances revolutionary) view of property that there was, in any case, no real or ultimate conflict between the concepts of private rights and public interest. Eventually and inevitably they coincide, reconciled, Adam Smith said, by a providential "invisible hand." If the individual acts to maximize his own short-term economic interests, then inevitably all of society will benefit.

[1]It is not always easy to distinguish sharply between legal and philosophical issues, certainly not in the case of land-use policy. Legal and philosophical developments go together, often in a leapfrog sort of way. We add this as a cautionary note, for much of what follows is already being modified in the courts or finds a different interpretation there.

[2]Anyone interested in the foundations of land-use policy is well advised to look at Locke's discussion "of property," Chapter V of his *Second Treatise of Government*. It should be added that Locke's views were broadened, and in certain ways debased, by a host of interpreters, and some of what passes for "Locke's view of property" cannot be found in the original.

Locke's view of property, as mentioned above, had become generally accepted by the eighteenth century when American institutions were formed. It was mirrored in a variety of ways. The Virginia Bill of Rights (1776), for example, declared that among the rights of men were "the enjoyment of life and liberty, with the means of acquiring and possessing property, and pursuing happiness and safety,"

Property rights became accepted as a fact of life in the United States

while the Massachusetts Bill of Rights (1780) stated that all men have certain natural, essential, and inalienable rights among which may be reckoned "the right of enjoying and defending their lives and liberties; that of acquiring, possessing, and protecting property; in fine, that of seeking and obtaining their safety and happiness."[3] There were other reasons, moreover, why Locke's view of property became particularly well entrenched in the United States, to the point where it was no longer taken as a *theory* about the disposition of land or an ideology which stressed the fundamental importance of individual human rights, but as a *fact of life*. Four reasons might be mentioned.

In the first place, there was a close (and continuing) connection between property rights and social freedom, a natural connection to make for a people who left Europe originally for social and economic reasons. Owning property was (and still is) a way to attain social freedom. In the second place, there was an abundance of land, in theory, at least, "enough for everyone." There was little perception of that scarcity which invariably supplies the first motives for land-use controls. In the third place, the population was relatively diffused—even today, England and Wales, although approximately the same size as North Carolina, have nine times as many residents—and there seems to be some sort of general correlation between density and the restriction of land uses. In the fourth place, there were the conditions of frontier life. Locke had asserted that what entitles a man to own land is the fact that he has "mixed his labor with the soil"[4] (compare the requirements of the Homestead Act of 1862). But hacking out an existence in frontier conditions was certainly to mix one's labor with the soil. To survive was already to succeed. The frontier past is still so recent in Montana, in fact, that this view—a man can do what he wants with what is pretty much his own creation—is very much alive.

Difficulties Inherent in the Traditional Framework

Now alongside this very brief history of these concepts of property, a contemporary fact must be set: so far no one has been able to formulate a consistent land-use policy which has been able to gain anything like general support. As a recent governmental commission (one among many) concludes:

> . . . task forces [studying the problem have] found it easier to sketch out a range of sometimes consistent, sometimes inconsistent, programs than to define a set of coordinated growth and land development policies. Words like "balanced" or "rational" growth simultaneously seem to reflect a desire to set land use objectives and in inability to achieve consensus relative to what these objectives ought to be.[5]

[3]See Norman Wengert, "Legal Aspects of Land Use Policies, Plans, and Implementation," *National Land Use Policy* (Ankeny, Iowa: Soil Conservation Society of America, 1973).

[4]"It being by him removed from the common state nature has placed it in, it has by this labor something annexed to it that excludes the common right of other men. For this labor being the unquestionable property of the laborer, no man but he can have a right to what that is once joined to, at least where there is enough and as good left in common for other." Note the importance of the final clause.

[5]*Urban Growth and Land Development: The Land Conversion Process*, Report of the Land-Use Subcommittee of the Advisory Committee to the Department of Housing and Urban Development (Washington, D.C.: National Academy of Sciences, 1972).

But why has there been this failure to achieve consensus?

Surely one reason for the failure is a basic lack of information. Despite a seeming avalanche of technical studies, there is still much we do not know, particularly with regard to local land resources.[6] Lacking such information (often proceeding, in fact, on the basis of misinformation) it shouldn't be surprising that consensus on land-use policy is so difficult to come by.

There is also the fact that at the present time there is a great deal of institutional uncertainty. Who is to formulate and implement land-use policy? At what levels of government and in what ways? Until these sorts of questions receive answers, it will be difficult to formulate policies which achieve consensus. Both the present institutional uncertainty and the attempt to provide answers are reflected in the flood of legislation on the local, state, and federal levels to bring new land-use agencies into existence.

But we suggest as a third reason that we have failed to achieve consensus because there are some basic difficulties with the structure of values and concepts in terms of which we think about land-use policy. In particular, there are certain inherent conflicts in our concepts of private rights and public interest and in the values associated with them.

For a long time these conflicts were disguised from us, on the one hand by the widely shared belief (no apparent evidence to the contrary) that short-term economic self-interest inevitably coincided with long-term social benefit; on the other hand by the continued abundance of land and the relative absence of competition, especially in rural areas, between incompatible uses of land.

But the environmental impact of pollution in its various forms and widespread dissatisfaction with the character of urban and suburban development have led to doubts being raised about the validity of the *laissez-faire* belief; and the rapidly increasing

demand for land (for suburban and recreational purposes primarily), together with new difficulties in the conversion of land from one use to another (e.g., prime agricultural land being converted to suburban development, or so far "unused" land being converted to agricultural purposes) has led to an emphasis more on the finite character of our land than on its abundance.

Necessary land-use controls conflict with our concept of private rights, requiring some changes in our philosophy

In our view, the only way out of the policy impasses in which we now typically find ourselves is in modifying, possibly even in replacing, some of our traditional concepts and values. This is a large claim, one difficult to make precise and to prove. We hope to make it at least plausible by examining the philosophical foundations of various land-use controls.[7]

[6]Of particular importance to Montanans is the study of the Gallatin Canyon sponsored by the National Science Foundation and carried out by a team from Montana State University. This study includes not only a variety of data, but also a description of methods which can be used to inventory land resources, uses, and potential impacts.

[7]Granting, what we have not demonstrated but in fact believe, that some such controls are necessary in the first place.

The Problem of Rural Land-Use Controls

There is little need, we think, to find a justification for planning. It is virtually axiomatic that some planning is better than none, although of course important questions can be raised regarding *who* does the planning and with *what purposes* in mind. The tough questions arise in connection with general goals and the implementation of the plans (questions legal, political, social, and economic), with the control of land uses. Here philosophical foundations for our policies seem to be very much needed. What follows is a brief survey of foundations for controls that have been used or are now proposed, with the emphasis heavily on rural and agricultural areas.

Zoning.[8] The first zoning laws in this country were adopted in New York in 1916 and rapidly thereafter in other cities and states. Zoning authority from the beginning rested on the police power of the community, more narrowly on nuisance doctrines (i.e., uses jeopardizing public health, safety, morals, and the general welfare were disallowed). This zoning, so far pretty much restricted to urban areas, has been essentially negative in character (prohibiting certain uses of property) and seems in many cases to have been intended largely to preserve local property values. Much the same thing can be said, we believe, of subdivision regulations (drainage requirements, street width and grade, street lights, etc.). Moreover, it is not clear to what extent urban zoning and subdivision regulations have succeeded, given the fact that urban and suburban development has not for the most part resulted in "rational and attractive" communities. Possibly lack of comprehensive planning in connection with urban and suburban growth is in part responsible.

Some rural zoning has been attempted, so far on a limited basis. But the prospects for zoning as a way of controlling rural land use are uncertain, at least against the background of traditional concepts and values. Rural zoning, in particular the attempt to keep certain areas from ever being developed, seems implausibly based on the police power or on nuisance doctrines. These doctrines are rooted in part in the idea that a man is free to act as he pleases insofar as he does not endanger the safety or infringe the rights of others. But in rural zoning cases where the *type* (and not simply the character) of land use is at stake, consideration of the infringement of the rights of others seems to be for the most part irrelevant. This is not to say that nuisance doctrines cannot be broadly construed. By a 1700 law, all houseowners in Philadelphia, Newcastle, and Chester were required to plant shade trees for reasons of health. And the nuisance doctrines provide a broad basis for anti-pollution legislation (consensus concerning such legislation is usually not very difficult to obtain). But general rural zoning of the kind indicated above seeks to conserve rather than to prohibit certain uses of land; it is not so much negative as positive in intent; and it appears to have little or nothing to do with the protection of property (i.e., short-term economic) values.

If rural zoning for purposes other than to restrict certain kinds of subdivisions has a foundation (whether or not it would prove to be effective), it is that it is in the public interest to maintain designated areas as cropland, rangeland, woodland, etc., or for recreational purposes. But—and this is the point we want to make—it appears that a foundation of this kind, on the basis of the public interest, is incompatible with our inherited concept of private rights; for zoning of this kind would, at least in individual cases, prevent a landowner from maximizing the economic potential of his land. As John Cribbet puts it, "The right to use can be reasonably regulated, but at some point regulation becomes taking and constitutional guarantees come into play."[9] That point, of course, is located squarely in the middle of a gray area, one blurred aspect of which is the notion of "fair return." And conceivably the concept of the public interest, which is being used increasingly as the basis for land control legislation, will eventually suffice as a foundation for far-

[8]The following discussion draws on Wengert, *op. cit.*, pp. 150 ff. We don't intend in our discussion to prejudice the very complicated legal issues involved. The legal (and also the philosophical) situation should become clearer when a number of outstanding zoning cases now before the courts come to judgment.

[9]"Changing Concept in the Law of Land Use," *Iowa Law Review*, Vol. 50 (1965).

reaching rural zoning. But if it does, then the concept of absolute fee simple ownership will have been seriously diminished.

Persuasion and Voluntary Cooperation. Historically the most important, although arguably not the most effective, has been persuasion (public education, etc.) and voluntary cooperation (e.g., through the programs of the Soil Conservation Service). Persuasion and voluntary cooperation are, of course, perfectly compatible with the inherited doctrine of property and individual rights. But although the results of persuasion and voluntary cooperation are often unfairly downgraded, it remains understandably true that owners of land have been persuaded and have cooperated in just those cases (e.g., weed control) where they could see short-term economic gain. Furthermore, voluntary cooperation would not only not justify land control legislation, it would preclude it.

Government Ownership. Also important, not so much for the preservation of agricultural as of forest, recreational, and wilderness lands, has been governmental ownership.[10] (The federal government, through the Bureau of Land Management, leases millions of acres annually for grazing purposes.) This way out of policy impasses avoids conflict with the doctrine of property rights, the owner having been duly compensated for his land, and perhaps for this reason it is increasingly being urged as national policy. But it is not clear that governmental ownership, on a general scale, does not conflict with other traditional values —notably the right to own property—or compromise individual freedoms. Moreover, and this is more an empirical than a conceptual consideration, on a very large scale (e.g., in connection with the preservation of millions of acres of cropland) public ownership—with land being leased back to farmers—seems wildly impractical because it is so costly.

[10]Are there differences between forest or wilderness lands, on the one hand, and agricultural lands, on the other, which make governmental ownership appropriate in the one case and not in the other? It's interesting to note that national parks and wilderness areas historically have been in areas where other land uses were not possible or not particularly profitable.

"National Acreages." A variant on the last idea, so far only suggested, is the creation of "national acreages," tracts of high-quality agricultural land (Florida citrus land for example) on the model of national parks. Such national acreages could be either publically owned and privately leased, or privately owned and publically restricted as to use (on the basis of national legislation rather than local ordinance). In the first case, conflict with the doctrine of private rights is avoided, at the likely expense of other traditional values. In the second case, the doctrine of absolute fee simple ownership is further diminished.

Subsidies. A third method of controlling rural land use has been the payment of subsidies, either to encourage certain uses of land (e.g., government cost-sharing programs to encourage soil conservation practices) or simply to make it economically possible, even profitable, for the land to continue as agricultural. This method is particularly important in certain European countries. In Switzerland, for instance, where preservation of a domestic agriculture is thought to be essential to Switzerland's survival in the event of war, farmers are paid a subsidy for each calf raised. But again, to the extent that subsidies have been given (invariably on the basis of the general welfare) the concept of private rights has been eroded. As any recipient of government subsidies knows, he gives up certain things in return.

Beneficial Assessment. Of increasing importance (e.g., in California and Maryland) is the institution of beneficial tax rates. Following this policy, an owner of land receives preferential tax treatment in return for his agreement not to develop his land for some specified period of time. But questions concerning the equity of such arrangements have been raised and, as before, the owner has in effect traded away some of his rights.

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This survey of land-use controls, some of them local, some national, is not exhaustive. But we think it indicates that any of these controls except persuasion—zoning, public ownership, or subsidy (direct or by way of tax benefit)—would entail changes in our traditional conceptual and value structures. If land-use controls are necessary and if

people are unwilling to change these traditional structures, then clearly we are in a bind from which the only escape is the simple exercise of *power* to settle land-use problems as they arise.

New Foundations for Land-Use Controls

We said at the outset that the job of a philosopher is to make explicit concepts and values, to anaylze them, and, if necessary, to suggest new ones. The case for at least some land-use controls has been very well argued, in our opinion, in *The Use of Land*, a task force report sponsored by the Rockefeller Brothers Fund.[11] As this report suggests, a new mood is developing in America which places increased emphasis on planning and control. Since the concepts in terms of which land-use policy has traditionally been discussed no longer seem completely adequate, failing to provide a basis on which consensus can be reached or to indicate a justification for new legislation or institutional change, it might be wise to at least consider some new concepts, different questions, alternative images of possibility.

First suggestion: Development of a concept of landownership which recognizes the *duties* of a landowner as well as his *rights*. This is the concept of property with which we began, the landowner as steward or trustee. No one is suggesting a return to the feudal order, or an abandoning of those individual rights and freedoms which were won with such difficulty and which constitute the permanent legacy of the European Enlightenment. Rather, the suggestion is that *one* aspect of the feudal concept of property be retained: that ownership confers certain obligations and responsibilities, as well as certain privileges. At present, in the words of Cribbet,

> . . . private property, though admitting that it can exist only by virtue of public protection, pleads payment of taxes as the whole price of that protection, and beyond that claims immunity from all sorts of obligations.

Yet, one could argue, it is just the refusal to countenance these obligations that has been responsible for the degradation of the human and natural environment in this country.

[11]William K. Reilly, ed., *The Use of Land: A Citizens' Policy Guide to Urban Growth* (New York: Thomas Y. Crowell Company, 1973).

The suggestion is akin to that made by Aldo Leopold in his epochal book, *Sand County Almanac* (1949). At the heart of what Leopold wants to say is this:

> All ethics so far evolved rest upon a single premise: that the individual is a member of a community of interdependent parts. His instincts prompt him to compete for his place in that community, but his ethics prompt him also to cooperate (perhaps in order that there may be a place to compete for). The land ethic simply enlarges the boundaries of the community to include soils, waters, plants, and animals, or collectively: the land.

Our values framework, Leopold proposes, should be so enlarged as to include room for the idea that land places obligations on us, communal obligations, which transcend economic self-interest.

This concept, restricted to landownership, would require no great revolution in consciousness. It is implicit in the attitude of many, if not most, men who take their living directly from the soil. But unless amended it seems capable only of underwriting conservation practices and of limiting abuses. Leopold develops his idea of a land ethic in such a way that it provides a far-reaching justification of wilderness.[12] But it is not easy to see how it could be adapted to argue that certain areas remain permanently as cropland, for instance.

Second suggestion: Development of a concept of landownership which does not directly prohibit profits on land transactions, but specifically denies the owner the right to urbanize. This suggestion is prominent in the report of the Rockefeller Brothers Fund.

> Ownership of open spaces without urbanization rights should become as common as ownership of land without mineral rights. A changed attitude toward land—a separation of ownership of the land from ownership of urbanization rights—is essential. Historically, Americans have thought of urbanization rights as coming from the land itself, "up from the bottom" like minerals or crops. It is equally possible to view them as coming "down from the top," as being created by society and allocated by it to each land parcel.[13]

[12]Note that neither "private rights" nor "public interest" (at all narrowly conceived) allows one to mount a defense of wilderness.

[13]Reilly, *op. cit.*, p. 22.

The basis for the historic American attitude is, once again, John Locke's view of property, that the rights which possession of it confers are prior to government and law. To accept the present suggestion is to reject this view. In fact, the philosophical basis for a rejection was set out over 100 years ago by the Utilitarian philosopher Jeremy Bentham. Bentham asserted that "Property and law are born together, and die together. Before laws were made there was no property; take away laws and property ceases." This account of the origin of property seems more plausible than Locke's. And since it entails that property is a social product, it would seem to follow quite naturally that therefore society has the right to regulate its use.

This suggestion, although it would require a substantial change in our Lockean framework of concepts and values, would license extensive land-use controls. In practice it would undermine the speculation in land (better perhaps: would insulate land uses from market forces) which is such an important source of environmental problems. As it is, the suggestion might not be as radical as it sounds. Not only does the government retain mineral rights in privately owned land, but, perhaps more to the point, *owns* the groundwater on private land in many western states.[14] The landowner has no more right than to use the water for beneficial purposes. In the beginning, this appropriation (without compensation) of water ownership by several states was bitterly contested (successfully in Arizona). By now it is regarded as commonplace and in no way is taken to infringe on property rights.

Third suggestion: Replacement of the concept of *conservation* with the concept of *creation*. Again, something like this suggestion is made in *The Use of Land* ("It is not enough to think only of conserving what we have. Conservation must be part of a larger effort to create what we want."). This time the focus is on the concept of development. Just as the concepts of private rights and public interest traditionally stand opposed, making consensus on land-use policy so difficult to come by, so the concept of development traditionally stands opposed to the concept of conservation. But this second opposition obscures the fact that some kinds of development are better than others, and oversimplifies many of the issues involved. We think it is more useful to think in terms of the creation of a desirable environment. The concept of creation subsumes and to an extent harmonizes the concept of development and conservation; for to create is in some sense to develop, while at the same time it is to apply very high criteria—involving a recognition of human values—to such development. The concept of creation entails an effort to develop the types of communities and landscapes we wish to inhabit, unlike the concept of zoning, for example, which seeks only to discourage certain local practices. And unlike the concept of conservation, which tends to be advanced by those who have no real quarrel with the status quo, the concept of creation does not frustrate the desires of the poor and underprivileged.

Fourth suggestion: Replacement of the concept of *rights* with the concept of *needs* in discussing land-use issues. There are many difficulties here. Needs are notoriously difficult to determine, depending in part as they do on psychological considerations. Neither are we yet at that point in time where needs can determine land uses from a national point of view. Uses are not yet serious competitors from a national perspective. Which is

[14]A point brought to our attention by Robert Dunbar.

to say that land-use problems are still, and for the near term, pretty much local. The question is not "Do we want a major recreational development in the Gallatin Canyon?"[15]

Nevertheless, there seem to be distinct advantages in replacing the concept of rights with the concept of needs. Historically there is a close connection between rights and needs (recall that the right to bear arms originated in the conditions of frontier life). But it is to be wondered whether the sixteenth and seventeenth century needs to which the Lockean doctrine of property rights responded are still our own. Whether they are or not, it is useful to keep rights always in the perspective of needs.

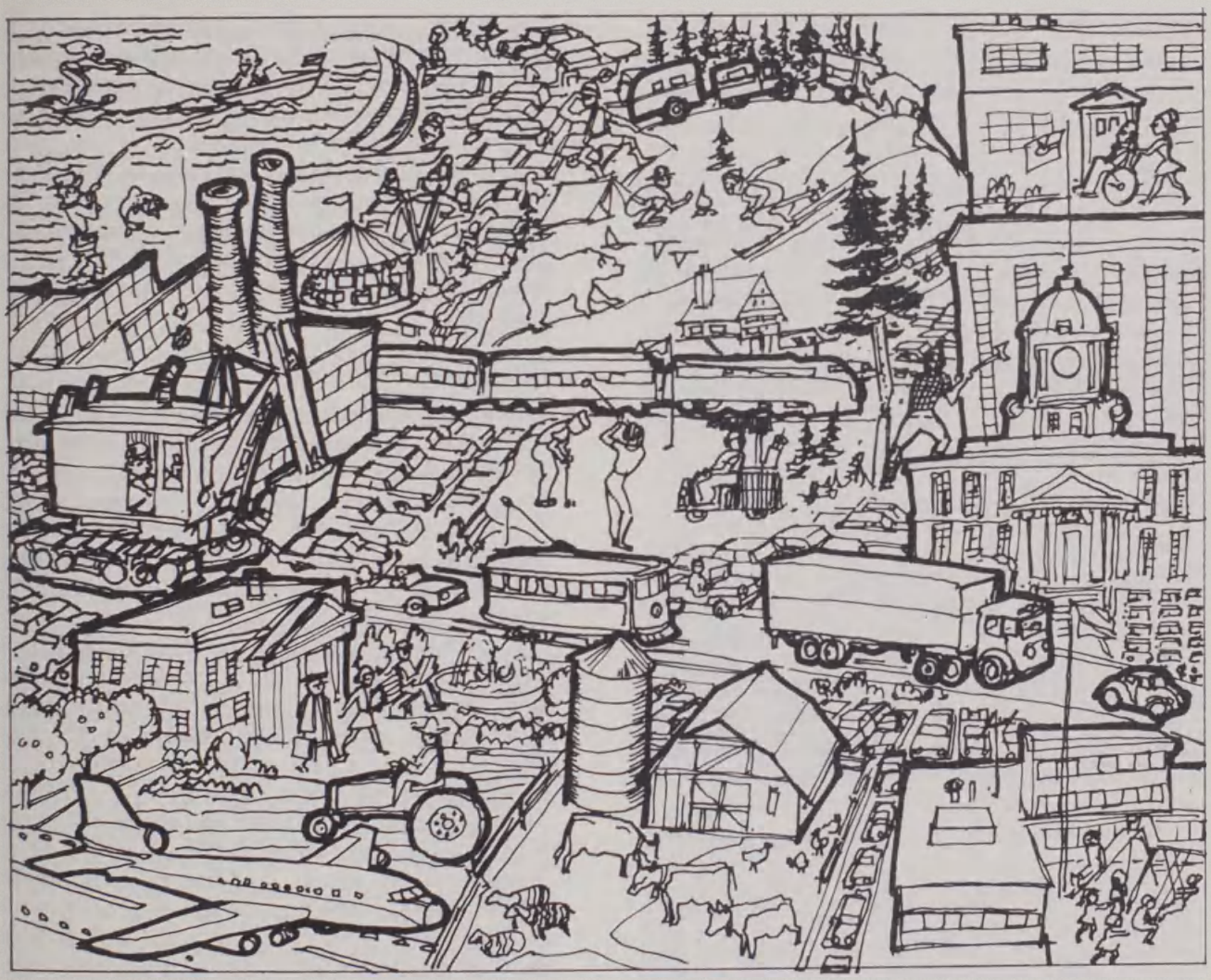
Moreover, the concept of rights (at least as regards property, and in its unmodified form) seems to be partly responsible for our present difficulties, in particular for our failure to reach consensus on land-use policy. A consideration of needs should help to break the impasse. Perhaps to say this is to say no more than that we should operate with an enlarged concept of the public interest. Certainly the case presented by such thorough studies as *The Use of Land* is premised almost entirely on a consideration of needs.

[15]Although few would want to argue that we *need* more urban sprawl.

Finally, the concept of needs, unlike rights which are uniquely human, allows us to consider the needs of plant and animal life, and of the land itself. It thus provides the basis for an ethical-biotic community of the type Leopold envisions and in this way further justifies legislation and institutional change designed to meet these needs and thus to ensure the survival of the community.

Conclusion

It is not clear whether philosophers are out in front or whether they bring up the rear in discussing implicit conceptual and value structures. But at this point we can't resist quoting the German philosopher Hegel, who wrote: "When philosophy paints its gray on gray, then has a form of life grown old. The owl of Minerva takes to flight only at the coming of dusk." What Hegel meant, of course, is that philosophy is inevitably retrospective, disengaging the most general features of a form of life only when it has begun to harden and decay. Ironically, amid our suggestions that changes in some of our values and concepts might be made, is the realization that such changes are apparently already under way, even to our concept of land itself. At the very least, we can try to become sensitive to the directions these changes are taking.



Land-Use Planning on Public Lands

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Photographs courtesy of U.S.D.A. Forest Service.

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The decision-making process in public resource management is complex. This is how it's done on the Beaverhead National Forest in southwestern Montana

Most land-use conflicts grow out of differing values that different publics hold toward public land management. The conflicts may be caused by competing demands or may be the result of demands that inflict damage upon the land's producing capabilities. A major problem in public land-use planning is the identification of the best land management direction while considering differing public values and anticipating unforeseeable future variables.

Intensifying Competition

Competition for the use of available land is increasing, land management decisions are becoming more complex and more difficult, and there are no signs that this trend is likely to change in the near future. The problem is that everyone wants as large a piece of the "pie" as possible—usually without an understanding or regard for the values of other people. Value differences, as expressed by various segments of the public, are a constant factor in the increasingly complex process that leads to land-use decisions.

The other major factor is the land itself. Not everyone realizes that a forest is an integrated and dynamic system of biotic and abiotic components in a state of equilibrium, and that although the land may sustain some actions with only minor equilibrium shifts, other actions can disrupt this balance and diminish the value of the land.

Man is an integral part of the land system. Of all its components, he has the unique ability to consciously choose the role he will play. If we are to foster an enduring and viable society, it is necessary that we use the land wisely now and consequently maintain or increase its values in trust for future generations.

National, International Need

The need for land-use planning is being recognized by more and more people. Its importance transcends national boundaries. "Land use is the single most important element in conservation today. What we do with our land and resources is literally the key to our survival. How we plan for their use, now and in the future, is our greatest environmental challenge."[1]

Russell Train, administrator of the U.S. Environmental Protection Agency, in announcing EPA plans for a new unit in the agency to deal with all aspects of land-use problems, called land-use planning "the Nation's No. 1 environmental problem."

Resolving Conflicts

Decision-makers must understand the land, with its various use opportunities and constraints, before they can resolve conflicts. Although general knowledge about the land (e.g., ecosystem theory) is extensive, detailed knowledge about land complexities may be inadequate—as is the case on the Beaverhead National Forest. This presents a planning problem.

It will always be difficult to design a balanced land-use program that will satisfy both individual needs and public priorities. An adequate data base, continually updated, is essential to the development of an optimum program. In considering what values to assign to the various land-use opportunities and land-capability limits, it is also necessary to remember that each land-use decision limits future land-use options. These commitments of time and space may be temporary or may have long-term effects. Will today's decision be in tune with tomorrow's needs?

Some people believe that National Forests should be used only for the production of a commodity such as timber, forage, minerals, or water. Current shortages of these commodities in the marketplace add stress to this emphasis. Others believe that the public lands should be reserved only for aesthetic, recreational, and environmental benefits. The latter view reflects the general affluence, mobility, increased leisure time, and new environmental awareness of a large segment of the public. Achieving a mixture of these benefits is the responsibility of public land managers, as

[1] *American Forests*, Vol. 80, No. 8 (August 1974).

directed in the Multiple Use/Sustained Yield Act of 1960, for "managing the [National] Forests for the combination of uses that will best meet the needs of the American people. . . ." The problem is, what is best?

The forest land base is limited, both in size and in its benefit-producing capacity. When land resources were abundant in relation to demands, conflicts could often be resolved by simply redirecting the demands to other areas of supply. But today, with land resources becoming increasingly scarce, the past system is becoming less and less feasible. The range of options for satisfying the varying demands for land-use benefits is narrowing; the recognition of trade-offs is expanding.

Use Demands Increasing on the Beaverhead

It is apparent that there is increasing regional and national interest in southwestern Montana and the Beaverhead National Forest. Much of this new regional and national interest is amenity-oriented, as compared to the extractive orientation of the local economy. It is expected that the influx of new residents will continue as the area becomes better known and more people are attracted to the scenic environment and appealing, slow-paced lifestyle.

At the same time, the local area is shifting from a primarily agriculturally-based economy to a broader base of education, government services, tourism, and mineral activity. This will produce conflict within the communities and between local and outside groups, with conflict intensifying in proportion to the increase in threat to the lifestyles of the people involved. As all this activity increases, so will the importance of the Beaverhead National Forest increase—and, as a consequence, the decisions made in the allocation of its resources.

Conflict Not Negative

Conflict in and of itself is negative only if the way in which it is handled leads to undesirable consequences. Conflict can be constructive when brought out in the open and properly resolved by centering on the problems and emphasizing similarities of interests in a way that results in solid, realistic land management alternatives.

We are fortunate that advanced technology in computer and operations research, and in biological, natural, and behavioral sciences is available to assist the land manager in his effort to achieve the greatest benefits possible from the public lands with due regard for people's needs and land capability. Never before has the challenge been as great.[2]

Managing Conflict

Strategies for managing conflict are based on the assumptions and expectations of the groups involved. Estimates of land capability under the various uses are then made, with activity costs and benefit values developed for each use.

Obviously the National Forests cannot meet everyone's needs and support all lifestyles. Determining the appropriate resource uses

[2]To provide land and resource management direction, the staff of the Beaverhead National Forest has published a 32-page *Multiple Use Plan*. Earlier this year a 96-page booklet, *Socio-Economic Overview for Unified Planning*, was published to identify the current and projected socio-economic demand trends of the public in terms of local, regional, state, and national relationships that local, regional, state, and national segments of the public have to the Forest. This information is used to display the land management alternatives that are developed during the planning process. When supplemented with data received from the public, this information aids the National Forest land managers in determining how the land base should be used.

compatible with people's lifestyles and land capability is now crucial, but little research has been done in this field.

The immediate task is twofold. First, the information and theory already available must be translated into a form relevant to land use, including an operational definition of human needs and lifestyles. Second, but no less important, is the need to translate the information contained in such an overview into a field-usable method that fits into existing resource allocation systems. Work on either or both can be started immediately; ideally, both would be developed at the same time.

Currently, the land manager is forced to make decisions without adequate data dealing with the effect of these decisions on land uses. The immediate goal is to give him as much information as possible from which to make better intuitive or experience-based decisions.

No land manager can keep in mind all the facts relevant to an individual land management decision. Nor can he keep in mind the effect his decision will have on all other current and future decisions. The ultimate goal, therefore, is a system whereby all the thousands of pieces of relevant data can be utilized. With such a system, decision outcomes can be simulated, outputs, costs, and opportunities foregone analyzed, and resources optimally allocated, based on realistic predictions of the future.

Interdisciplinary Team Efforts

The increasing complexity of land-use problem-solving has led toward interdisciplinary team efforts and away from single-function approaches. The perspective needed to coordinate an administrative unit's activities, or to otherwise deal with them, is beyond the scope of any individual decision-maker. Recognizing and resolving problems requires information about how proposed actions relate to each other and about all the future effects of alternate combinations of these proposed actions—information that is not readily available with traditional approaches. The ultimate goal of the planning process is the formulation of resource allocation plans that will meet the needs of the people, both now and in the future, in a manner consistent with the capability of the land to support these needs.

Systematic Method Required

A systematic method is required in dealing with the needs of the people, the capabilities of the land, and meeting the responsibilities prescribed by: (1) the Multiple Use/Sustained Yield Act; (2) the National Environmental Policy Act; (3) Presidential Executive Orders; (4) regulations by the Secretary of Agriculture; (5) other congressional legislation; and (6) Forest Service directions from the Chief of the Forest Service and the Regional Forester. In the growing competition for limited land and resources, the traditional question of "Can the land bear the use actions contemplated?" has to be expanded to include "and should the actions be practiced in light of other land-use values?"

The overall National Forest land management goal is to optimize public benefits from the public land while maintaining the long-term productivity of the land. Subject to specific constraints, this means that all resources of the Forest are to be managed in a manner that makes the most of their aggregate value rather than of any one resource in isolation. This is in keeping with the direction of the Multiple Use/Sustained Yield Act for "harmonious and coordinated management . . . with consideration being given to the relative values of the various resources . . . ."

To achieve this overall goal, three major planning objectives must be attained:

- **Determine how the Forest land base CAN be used** (on the basis of identified land-use opportunities, land capability limits, etc.).
- **Determine how the Forest land base SHOULD be used** (on the basis of identified current and projected social and economic demand trends as expressed by local, regional, and national segments of the public).
- **Determine how the Forest land base WILL be used** (in both long-range and short-range terms, on the basis of an identified range of choices available in managing the land to produce public benefits. This is done in open participation with various segments of the public so they are both informed and involved in the problem solution.).

There are three significant constraints in developing these planning objectives. They are:

- **Land capabilities:** No activity may be allowed if it will result in the destruction, depredation, or diminishment of the land's long-term productivity.
- **Sustained yield management:** All resources are to be managed on a sustained yield basis.
- **Funding constraints:** The intensity of local management is dependent on the investment level and the manner in which these investments are utilized.

In the case of conflicting demands, the land management goal is attained by focusing on the requirement for "optimizing public benefits"—or, which option offers the greater total value. The analysis should show clearly how the values of the various resources were derived and related in determining the total values of the alternative uses. If requested, this information should be made available to the parties involved in the conflict.

When the conflict is between demand and the land's capabilities, the analysis must relate the impacts anticipated from the proposed uses (e.g., logging methods, recreation visitation rates, grazing intensity) to the varying capabilities of particular land areas to absorb such impacts. Land management options should be eliminated from further considerations when they exceed the land capability limits established by this analysis. Current management (existing uses) should also be related to these land capability limits and altered as may be necessary.

The sustained yield constraint is designed to ensure "the achievement and maintenance of a high-level annual or regular periodic output of the various renewable resources . . . without impairment of the productivity of the land," according to the Multiple Use/Sustained Yield Act.

The productivity limits of the various resources, relative to the application of the different land management options, must first be established. Appropriate intensity of use must also be established as part of the determination of "optimal" land management programs. These use rates, based on the productivity limits of the various resources, are then used as the basis for countering demand pressures that would exceed the sustained yield constraint.

It is difficult to design a balanced program that satisfies both human needs and public priorities. After an optimum program is developed, budget priorities, manpower, legal processes, and other limitations can act to impair the timely realization of a balanced program. Through the planning process, land managers can demonstrate the consequences and constraints of alternative management programs.

Planning Process

The planning process is structured to achieve the three planning objectives listed above: (1) land-uses/land-characteristics relationships analysis will determine how the land base *can* be used; (2) land-use demands analysis determine how the land base *should* be used; and (3) land-use program formulation determines how the land base *will* be used.

Analysis of the relationships between land uses and land characteristics is the land-oriented portion of the planning process. Possible land uses, independent of current or projected demands, are compared with the characteristics of discrete portions of the land base to determine how the land base can be used in the technical sense. This is accomplished by means of a suitability analysis and a feasibility analysis. Both compare possible land management options with the results of land characteristics inventories.

PLANNING PROCESS LEVELS

Planning Levels	Primary Planning Level Purposes	Planning Area Scope	Planning Time Frame
I Long-Range Strategic Planning	Broad land-use allocations (long-range land-use program formulations)	Entire planning area (Forest-wide); millions of acres	20 to 100 years +
II Short-Range Planning	Refine broad land-use allocations and develop plans for managing specific parts of the Forest (short-range land-use programs formulation)	Specified planning units (portions of the Forest); 10 to 100s of thousands of acres	5 to 30 years
III Implementation Planning	Produce project designs or administrative documents in accord with the decisions made in planning levels I and II	Specific sub-units or sites (portions of units); fractions of thousands of acres	1 to 10 years

The Beaverhead National Forest's planning process is related to three planning levels. Each planning level is typified by progressively smaller time frames and planning areas. Each is designed to solve different aspects of the planning problems. Different kinds of data and differing specificities of data are required at each level. The degree of data detail necessary and the certainty of equalizing the planning decisions increase as we move from level I to level II.

I. **At the long-range, strategic planning level**, the focus is upon broadly identifying land-use opportunities and constraints and projected demands across the entire planning area. Tentative land-use allocations are made to establish a long-term Forest management orientation that is in accord with these parameters.

II. **At the short-range planning level**, the focus is upon refining and/or revising the broad allocations that were made under planning level I and to develop program alternatives for managing a specific part of the Forest. Plans will have sufficient detail to begin implementation or project planning. This is done within the contexts of planning units that were delineated at the long-range levels.

III. **At the implementation planning level**, plans are developed to activate the decisions made in planning levels I and II. Questions about how the land will be used have already been resolved by this time. Decision latitude is now limited to "how to do" concerns.

The planning process requires modifications in addressing changes in the management situation. For this reason, the master plan concept is inadequate. Demand changes and improved knowledge about the land and man result in both long- and short-range land management program alternatives. Periodic review and updating of the planning results are essential to the planning process.

This planning process is applicable at both planning levels I and II. The only real variables are time frames, spatial contexts, data needs, and data specificities. The same general goal and objectives are served at both levels.

Land Management Options

The vast amount of data available to planners must be classified and organized in a manner which is useable.

Now let us consider the concepts underlying each step in the planning process, relative to the planning goal and objectives in planning levels I and II.

Land management options are subcategories of major uses. For long-range strategic planning purposes (level I), the options are described

primarily in use-intensity terms. For level II planning purposes, they are described in terms of both use-intensity and actual use practices. Similar use benefit measures (e.g., acre-feet of water, recreation visitor days, cubic feet of timber), are used to describe the management options at both planning levels. By describing possible uses in management option terms, the planner strengthens his ability to more precisely relate land uses to land characteristics.

The *suitability analysis* is a basic screening procedure. First, criteria must be stated to describe the minimum land characteristics that must exist for a land area to be considered suitable for different uses. These criteria become a part of the basis upon which land characteristics inventories are designed and conducted. Upon completion of the inventories, the data are matched with the suitability criteria to isolate which land management options are open to specific portions of the land base. This narrows the total analysis field. It also acts to resolve potential land-use conflicts by specifying exactly where uses may be practiced. (Suitability analysis involves biological and environmental factors.)

The *feasibility analysis* is a more refined screening procedure. On those portions of the land base suitable for various kinds of uses, there also exist ranges of use feasibility. In other words, while an area may be basically suitable for a use, it may or may not be feasible to actually use it. As in the suitability analysis, sets of criteria must be stated to describe the minimum land characteristics for a land area to be considered feasible for any of the uses. These criteria are used to design and conduct the land characteristics inventories. Upon completion of the necessary inventories, the results are matched with the feasibility criteria to identify which land management options can and cannot be applied on specific portions of the land base in the foreseeable future. (Feasibility analysis involves practicality and economics.)

At this point, the more or less obvious natural constraints (i.e., defined suitability and feasibility criteria) have been studied to determine how the land can be used. The next step is to consider the relative cost/benefit/time relationships that pertain to the application of management options on the land base.

Computer Data Source

For the applicable land management options that remain—based on the inventoried land characteristics—benefit output levels/land capability limits are predicted. These data, along with output timestreams, cost timestreams, analysis time periods, benefit and cost index values, discount rates and other related data are fed into a computer program which forms a data matrix. This matrix serves as a data source for the linear program analysis that follows.

In the *alternatives formulation and analysis step*, the land data are related to land-use demand data to formulate a spectrum of reasonable management alternatives. In level I planning, a number of Forest-wide management alternatives are characterized by differing broad land-use allocation proposals. In level II planning, a number of land allocation alternatives are formulated for each designated planning unit. Level II alternatives will be in accord with level I planning decisions.

Assuming a fairly wide range of land-use demands, a number of land management alternatives of differing mixes of feasible management options can be generated. For each of these alternatives, there is an optimum course of management direction to maximize desired benefits while minimizing associated costs. To help identify the management direction, linear

programming provides a mathematical technique for evaluating optimum allocation of resources, along with other analysis techniques.

By stating definitive goals that reflect differing long- or short-range demand trends, various linear programming runs from the computer data matrix—constrained as desired—allow the planner to evaluate these factors:

- Quantitative benefit output levels, in either physical units or dollar values.
- Number of acres that would be used for different management options.
- Economic appraisal: cost/benefit summary or net preset worth.

Results of these computer runs can be analyzed for management option intercompatibility (in geographical terms); effects on ecological, aesthetic and other resource values; implied benefit trade-offs; management requirements (manpower, financing); etc. In this analysis, the information is displayed in both map and tabular forms. At this planning stage, no allocations are made; only alternative ways of allocating land have been defined.

Demand Analysis

The demand data used to structure the land management alternatives are derived from the land-use demand analysis. This is the man-oriented portion of the planning process. It identifies how land should be used on the basis of both the current and future demands by local, regional, and national segments of the public.

Demands are based on both economic and social parameters. Examples of economic parameters are population, income, employment levels, and income distribution. Examples of social parameters are hierarchical or human needs, lifestyles, and quality of life factors. Demand estimates are based on these criteria.

The land-use demand information inventory is primarily a review of available literature. In this inventory, data are interpreted in terms of their relevance to the planning area. These existing data are supplemented by public involvement data.

After analyzing these data, they are summarized as current and future land-use demand trends. The trends, in turn, are used to formulate alternatives and land-use programs.

Land-Use Program Formulation

In land-use program formulation, the analyzed land-use alternatives and demand trends are evaluated to determine how the land will be used. This is done in concert with the public in formal and informal review procedures.

For long-range program formulation, the previously generated Forest-wide management orientation alternatives are evaluated with long-range demand trends. From this comparison, an alternative, or a combination of different alternatives, is selected to "optimize public benefits" in the long run. The selected course of action is then analyzed and characterized in terms of sustained yield rates, program balance, and other factors. It becomes the umbrella document for subsequent planning decisions.

For short-range program formulation, the allocation alternatives for each planning unit are evaluated with short-range demand trends and the dictates of the long-range program. From this comparison, an alternative, or combination of different alternatives, is selected to "optimize public benefits" in the short run. These selected courses of action are then analyzed and characterized in terms of their effects on level I sustained yield rates, National Environmental Policy Act criteria, implementation schedules, and other factors. These documents then serve to guide the implementation planning that follows.

The land-use planning approach used on the Beaverhead National Forest is an initial attempt at systemizing various planning procedures by bringing functional planning decisions into a multi-functional and time context. It is not offered as the only method for achieving this objective.

The Beaverhead approach offers the benefits of computed-aided systems. Modern statistical and mathematical techniques help specify and evaluate management alternatives, aiding in the formulation of efficient and coherent management programs.

Summary of Method

I. **Determine how the Forest land can* be used by:**
- A. Inventorying and analyzing the land characteristics of the Forest to:
  1. Identify the total range of land-use opportunities such that the feasibility of applying various land management options, both current and at future points in time, can be determined.
  2. Identify the land capability limits of specific land areas that will constrain the current application of various land management options.

*Within the constraints of land capability and sustained yield.

II. **Determine how the Forest land base should* be used by:**
- A. Inventorying and analyzing the available land-use demand information applicable to the Forest to:
  1. Identify the current and projected social and economic demand trends of the public in terms of local, regional, and national origins.
  2. Identify the different ecological, cultural, and economic demand relationships that local, regional, and national segments of the public have to the Forest.

*As expressed by the local, regional, and national segments of the public.

III. **Determine how the Forest land base will* be used by:**
- A. Combining the information of objectives I and II to formulate various land management alternatives for the Forest in total and for specific planning units which will:
  1. Identify the range of choice that is available in managing the land base to produce various benefits.
  2. Identify the possible trade-offs, both positive and negative, upon local, regional, and national segments of the public that would result due to the application of the different alternatives.
- B. Analyzing this array of land management alternatives in relation to current and projected demand trends to:
  1. Formulate an optimal long-range land management program for the Forest which will:
     a. Maximize the social and economic benefits of the Forest resources through the selection of the land management alternatives (or combination of different alternative features) that will best satisfy this goal.
     b. Employ the analyzed demand trends, demand relationships and the opinions of the public to determine the best long-range land management program.
     c. Identify, in quantitative terms, the commodity and non-commodity benefit production levels anticipated by the application of this program.
     d. Identify the sustained yield rates that will be adhered to as the program is implemented.
     e. Identify how the land base will be allocated in terms of the land management options that will be applied to specific areas of land.
     f. Identify the trade-offs between commodity and non-commodity benefits that the implementation of the program will result in.
     g. Identify the effects, both positive and negative, upon local, regional, and national segments of the public that will result due to the implementation of the program.
  2. Formulate short-range land management programs for specific planning units which will:
     a. Adhere to, and specify how to implement, the dictates of the long-range Forest management program (Management Prescription).
     b. Specify the funding requirements, in terms of both funding levels and project- and activity-related funding allocations, that will be necessary to implement these programs.
     c. Identify the effects that inadequate funding levels and/or inappropriate funding allocations will have upon the attainment of the anticipated short-range and, consequently, the long-range land management program goals.
- C. Implementing and monitoring the effects of the short-range land management programs that have been formulated.

*Based on land characteristics and land-use demand relationships.

IV. **Organize the numerous planning factors that must be dealt with in realizing the above objectives by:**
- A. Utilizing a comprehensive, systematic, and adaptable planning process which will:
  1. Include the open participation by members of the public so that they are both informed of the planning procedures and concepts that are employed and involved in the land management problem solutions.
  2. Treat land management problems in their entirety so that multi-functional rather than single-function solutions can be attained.
  3. Employ the talents of an interdisciplinary planning team, assisted by the expertise of both in-service and private individuals, to deal adequately with the numerous planning factors.
  4. Take advantage of modern analytical procedures and tools to make possible the adequate consideration of the large amounts of data that must be analyzed.
  5. Constantly update both the long-range and short-range programs to keep them current with shifts in demand trends and refinements in land characteristics data.

Water and Electric Power in Montana

JOHN M. CROWLEY

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Photographs courtesy of Western Montana Scientists' Committee for Public Information Library, University of Montana, Missoula.

Montana has an abundance of cool, clear, sparkling, relatively high quality water.

This water currently generates about 97 percent of the electric power produced in the state. Although the relative importance of hydroelectric power promises to decline in the state, substantial amounts of water will be needed to increase the production of thermal-electric power. The relatively heavy precipitation in the mountainous portion of the state supports the forests on which Montana's important woodproducts industry is based. Precipitation in the plains portion of the state, although rather light, supports the rangelands and permits dry-land grain farming in eastern Montana. Water diverted from the streams supplies the irrigated fields, which make a

disproportionately high contribution, in view of the small acreages involved, to the total agricultural production of the state. The streams, lakes, and reservoirs constitute one of the key factors in the attractiveness of the state for recreation. The availability of water is important to several Montana industries although total water use by industry is very small compared to agricultural use for irrigation. Finally, Big Sky water supplies the domestic needs of all the towns and cities of the state.

Montana's water is not everywhere as clean and pure as tourist brochures and picture postcards might lead one to believe. It is shocking to discover that a number of streams in the Big Sky Country, as in the case of Lake Erie and many eastern rivers, fall into the category of "seriously polluted waterway." These include the Clark Fork from Anaconda to Garrison, the Missouri from Helena to Great Falls, the Madison River, and nearly the entire length of the Yellowstone downstream from Laurel.[1] Manufacturing industries may be cited as a source of water pollution in some of these cases (oil and sugar refining, slaughterhouses, and thermal-electric plants along the Yellowstone and the smelters at Anaconda and East Helena). Agricultural pollution (silt, fertilizers, pesticides, manure, etc.) contributes to the deteriorated quality of the rivers mentioned above and of many other Montana streams. The impacts of logging operations lead to the delivery of more silt and nutrients to the streams. Insufficiently treated sewage is a significant source of contamination in Montana's streams and lakes. Most Montana towns and cities release insufficiently treated effluent from sewage disposal plants into the rivers. Some of the lakes are virtually encircled by lakeshore cabins, each with its incompletely effective septic tank.

In terms of present use within the state, there is an enormous surplus of water which flows out of Montana to downstream areas. This does not necessarily mean there is a surplus in the water budget of the state as a whole, for the water is very unevenly distributed over the Land of the Big Sky.

[1]*Water Atlas of the United States* (Port Washington, N.Y.: Water Information Center, Inc., 1973), Plate 51.

Water, Water . . . but not Everywhere

In the case of water, as in that of most aspects of land and livelihood in Montana, there is a sharp contrast between east and west or, more precisely, between Great Plains Montana and Rocky Mountain Montana. Virtually all of the surface and ground water in the state is derived from precipitation in the mountains of western Montana and adjacent Wyoming and British Columbia. This includes the water in the streams that flow across Great Plains Montana. Moreover, there are important spatial contrasts in water supply within Rocky Mountain Montana.

The map in figure 1 is intended to bring out these contrasts and to show together, things that go together. It is what geographers call a composite or multi-topic map, one showing several different phenomena on the same base so they can be viewed in relation to each other. The map portrays precipitation, streamflow, reservoirs, and electric power generating capacity. In this way, streamflow may be examined in relation to the precipitation which produces it, and power plants may be viewed in connection with the reservoirs and streamflow to which they are related.

A major shortcoming of the map is that it is static. It portrays average annual precipitation and streamflow and shows power generating capacity rather than actual power output. It does not reveal the fluctuations over the course of the year and from year to year, in precipitation, streamflow, and electric power generation. A series of maps and graphs would be required to illustrate seasonal and annual variations.

Sources of Montana's Water

Montana's water is supplied primarily by precipitation within the state. A less important, but significant, source is inflowing streams. There are four possible sources of water in Montana:

1. precipitation within the state
2. inflowing streams
3. inflowing groundwater aquifers
4. interstate or international diversions

The first is by far the most important source of

water in the state and will be examined in detail in the next section of this paper.

Inflowing streams are significant, but not extremely important, in Montana's water supply. The largest inflowing stream is the Kootenai River, which traverses the northwestern corner of the state enroute from British Columbia to Idaho and thence back into Canada. A second significant case is that of the Yellowstone River and its south-bank tributaries originating in Wyoming. However, the combined flow of these streams at the points where they enter Montana is scarcely equal to the flow of the Kootenai.

The Milk River flows from the state into southern Alberta and back into Montana, but little water is contributed to its flow along its course in Alberta. In sum, inflowing streams are significant in Montana; but they are not nearly as important here as, for example, in the state of Washington, which receives huge quantities of water through incoming streamflow from British Columbia, Idaho, and Montana.

Inflowing aquifers are probably negligible in Montana's water supply. There may be some underground movement of water into the state through porous rocks and earth materials, notably in the area of Yellowstone National Park. It is

probably not significant in the overall Montana water picture.

There is presently no significant diversion of water, either into or out of Montana, through aqueducts or the like.

Precipitation

The greatest contrast in amounts of precipitation shown on the accompanying map is that between east and west. Rocky Mountain Montana is humid whereas Great Plains Montana is mostly dry. The southwestern two-fifths of the state, in the Rocky Mountains, fall in the two categories of heaviest precipitation on the map. The northeastern three-fifths of Montana, upon the Great Plains, fall mostly in the two categories of lowest precipitation. The boundary on the map between the two categories of heaviest precipitation, on the one hand, and the remaining precipitation categories, on the other hand, is the eastern foot of the Rocky Mountains.

The spatial arrangement of precipitation, like that of most other phenomena, is strongly three-dimensional and has an important vertical component in Montana. In much of the mountainous area, the valley bottoms are dry whereas the mountainsides are humid. Even within the mountain ranges themselves, precipitation increases from the foot to the tops of the mountains. In eastern Montana, the mountain outliers and some of the hills receive considerable precipitation while the plains and plateaus receive little. An attempt has been made to make the map three-dimensional in concept, even though the paper on which it is printed is flat.

Rocky Mountain Montana

There are strong spatial contrasts in the amount of precipitation within Rocky Mountain Montana. The area of heaviest precipitation is the northwestern part of the state, which the writer has named the Columbia Rockies.[2] This region includes the Lewis (Glacier National Park), Sawtooth, Flathead, Swan, Mission, and Bitterroot ranges and all of the mountains of the northwestern corner of the state. Here the mountain slopes generally receive thirty to forty inches of precipitation (in some cases a good deal more) and the foothills twenty-five to thirty inches. Precipitation is twenty to twenty-five inches in the valley bottoms, which

[2]The names of this and other regions in Montana were proposed in: John M. Crowley, "Environmental Regions of Montana," in *Montana Environmental Quality Council, First Annual Report* (Helena, 1972), pp. 2-11.

are humid and are, or were, forested.

The mountains in and around Yellowstone National Park constitute the second most humid part of Montana. This area, which the author calls the Yellowstone Rockies, englobes the Madison, Gallatin, Absaroka, Beartooth, and Bighorn ranges. It is similar to the Columbia Rockies in that both mountain slope and, with a few exceptions, valley floor are humid. However, precipitation in both the valley bottoms and the mountain ranges is generally lower than in corresponding locations in the Columbia Rockies.

The remainder of Rocky Mountain Montana, which the writer has named the Broad Valley Rockies and which includes the Flathead Valley south of Columbia Falls, is the least humid of the mountainous portions of the state. In this region the valley bottoms are semiarid (ten to fifteen inches of precipitation), the foothills subhumid (fifteen to twenty inches), and only the mountain slopes humid (twenty to thirty inches). In fact, the valley floors are as dry as the plains and plateaus of eastern Montana and were not forested.

Great Plains Montana

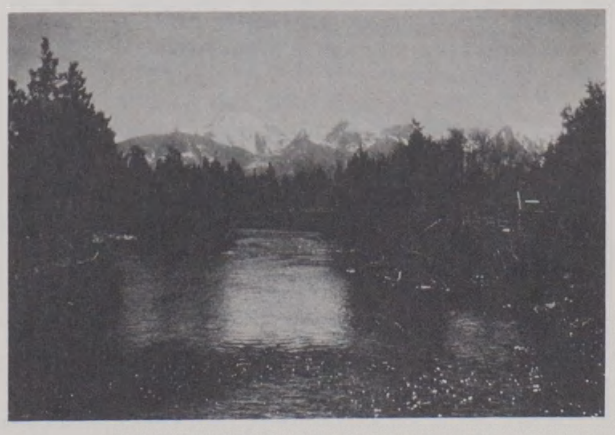
Precipitation in the foothills and higher plateau surfaces along the Rocky Mountain Front, and in the hills upon the plains southeast of Billings, is similar to that in the foothills of the Broad Valley Rockies. That is, these areas receive fifteen to twenty inches of precipitation and may be considered subhumid.

The Rocky Mountain outliers receive about the same amount of precipitation as the mountain ranges of the Broad Valley Rockies. The mountain outliers are the Snowy Mountains south of Lewistown, the Judith and Moccasin mountains north of Lewistown, the Highwoods east of Great Falls, the Bearpaws and Little Rockies southeast of Havre, and the Sweetgrass Hills northeast of Shelby. The plateau surfaces between these mountain outliers are semiarid like the other plateaus of eastern Montana. The foothills and all of the mountain outliers except the Sweetgrass Hills are included in a region which the writer calls the Rocky Mountain Foreland.

The remainder of Great Plains Montana receives only ten to fifteen inches of precipitation and is semiarid. Spatial variations in precipitation are not important except that northeastern Montana, the Two Rivers Region, is slightly less dry than the rest. Precipitation is lowest in the vast, forlorn ranching country of the eastern interior of the state (Big Dry Region) and the Triangle area (Sweetgrass Plains Region), although the latter has more arable land because of its smoother topography.

Water Yield

Not all of the moisture that is precipitated from the atmosphere shows up as streamflow to be used for hydropower generation, irrigation, recreation, or domestic and industrial purposes. Much of the precipitation that falls is evaporated back to the atmosphere before it is able to reach streams or percolate into groundwater aquifers. This evaporation is accomplished in two ways. One is by direct evaporation from the ground, water bodies, snow surfaces, etc. The other is by transpiration from the foliage of plants of the moisture they absorb from that which infiltrates into the soil. Transpiration by vegetation is much more important, in terms of the amount of water returned as vapor to the atmosphere, than direct evaporation. Evaporation and transpiration combined are called evapotranspiration. Potential evapotranspiration is the amount of water that can be returned to the atmosphere by evapotranspiration if plants are able to get all the moisture they can use. It is primarily a function of the heat of the climate. Precipitation minus potential evapotranspiration equals water yield.



Where precipitation is greater than potential evapotranspiration, water yield is positive, there is a water surplus, and the climate is classified as humid. Where the reverse is true, water yield is negative, there is a moisture deficiency, and the climate is classified as dry. Following is an outline of environmental conditions in Montana as they relate to water yield:

> Water surplus—Humid—Forest—Mountain ranges of Rocky Mountain Montana; Rocky Mountain outliers
>
> About equal—Subhumid—Prairie or park-land—Foothills of Rocky Mountain Foreland and of Broad Valley Rockies
>
> Water deficit—Semiarid—Short-grass steppe—Plains, plateaus, and most hills of Great Plains Montana; valley floors of Broad Valley Rockies

What happens to the water surplus that occurs in forested areas where precipitation is greater than potential evapotranspiration? Part of it runs directly off the ground surface and reaches the streams by means of overland flow. It is this surface runoff that causes erosion. The remainder, which infiltrates into the soil but cannot be held by the soil against the pull of gravity, percolates down to the water table and serves as groundwater recharge. It is the discharge (seepage) of groundwater into streams and lakes (unseen, below the level of the water in the stream or lake), and in the form of springs, that produces much of the flow of streams and keeps them running between rainstorms. Where there is little or no water surplus, there is little contribution to streamflow and negligible groundwater recharge. Exceptions are when it rains faster than the water can soak into the soil and when snow melts on frozen ground. Under these condtions, local runoff occurs even in areas having an average water deficiency.

Briefly stated, the semiarid plains and plateaus of eastern Montana and the valley floors of the Broad Valley Rockies have a pronounced water deficit and contribute little or nothing to streamflow and groundwater recharge. The subhumid foothills of the Foreland and of the Broad Valley Rockies have only a slight water surplus, and their contribution to streamflow and ground water is minor or insignificant. The humid, forested ranges of the Rocky Mountains and the mountain outliers of the Great Plains have a substantial water surplus. It is the forested mountain slopes—and virtually they alone—that provide the water for streamflow and groundwater recharge throughout Montana. Within the forested areas, the greater the water surplus, the greater the contribution to surface and ground water.

Streamflow

Volume of streamflow is shown by flow lines of variable width on the map in figure 1. The width of the line is proportional to the quantity of water flowing in the stream. Although the map does not reveal seasonal and annual fluctuations, it does reflect withdrawals for irrigation and other consumptive uses.

Columbia System

The largest river complex in Montana is that of the Columbia drainage in northwestern Montana. It is made up of the Kootenai River and the Flathead-Clark Fork river system. Both river systems receive nearly all of their water from the wet, heavily forested mountains of the Columbia Rockies Region, which has the greatest water surplus in the state.

The Flathead obtains its water from the eastern sector of the Columbia Rockies, that part east of the Flathead Valley. In terms of the volume of flow, the Flathead is the main stream; it is only because of an accident of history that the river downstream from the junction of the Flathead and Clark Fork was named the Clark Fork.

The Clark Fork receives much of its water from the Bitterroot range. Note how small are the Clark Fork and its tributaries in the Broad Valley Rockies upstream from Missoula. Two factors help explain this low flow. First, the ranges of the Broad Valley Rockies have a smaller water surplus than those of the Columbia Rockies. Second, there is considerable removal of water from the Clark Fork and its tributaries for irrigation in the Bitterroot, Flint Creek, Deer Lodge, and Blackfoot (Ovando area) valleys.

The combined flow of the Kootenai and Flathead-Clark Fork rivers at the Idaho boundary is greater than that of the Missouri and Yellowstone

after they join in North Dakota just beyond the Montana border.

Missouri System

The flow of the Missouri is slightly larger than that of the Yellowstone at the points where they leave Montana.

The relatively small volume of the Missouri upstream from Great Falls is a reflection both of the lower water surplus of the Broad Valley Rockies compared to the Columbia Rockies and of important irrigation withdrawals. Note that the flow of the river actually decreases from near Three Forks to Hauser Dam, reflecting irrigation use in the Townsend Valley. Among the three tributaries that come together to form the Missouri at Three Forks, the Gallatin and Madison rivers receive most of their water from the mountains of the Yellowstone Rockies, which have a greater water surplus than those of the Broad Valley Rockies. Each of these rivers is nearly as large at Three Forks as is the Jefferson, even though the drainage area of the Jefferson-Beaverhead-Big Hole system is much larger than that of the Gallatin and Madison rivers.

Two of the left-bank tributaries which receive their water from the Columbia Rockies, the Sun and Marias rivers, are about the same size, even after large irrigation withdrawals, as the upper Missouri tributaries at Three Forks. After receiving the flow of the Marias, the Missouri does not increase very much in flow until being joined by the Yellowstone. This is because the semiarid lands through which the river flows in Great Plains Montana have a water deficiency and contribute little to streamflow. The Musselshell and Milk rivers, the only significant tributaries of the Missouri in eastern Montana, have quite small headwater drainages in the Rocky Mountains, undergo important irrigation losses, and contribute little to the flow of the Missouri. A river such as the Missouri, which is flowing through a dry region but gets its water from humid areas upstream, is called an exotic stream.

Yellowstone System

Like the Missouri, the Yellowstone is an exotic river. The main river and its south-bank tributaries—the Clark Fork of the Yellowstone, Bighorn, Tongue, and Powder rivers—derive nearly all of their water from the mountains of the Yellowstone Rockies Region of Montana and the extension of this region in Wyoming. Although less humid than the Columbia Rockies, this region is significantly more humid than the Broad Valley Rockies. North-bank tributaries of the Yellowstone in Great Plains Montana are insignificant. After picking up the flow of the Bighorn River, its last major tributary flowing from the mountains, the Yellowstone does not increase much in flow and even decreases in places, reflecting large irrigation withdrawals in the Forsyth, Miles City, and Sidney areas.

In summary, all of the large rivers in Montana have their headwaters in the Rocky Mountains and receive nearly all of their water from the forested mountain slopes, primarily those of the Columbia Rockies and Yellowstone Rockies. This is true even of the Missouri. Although this river drains about two-thirds of the Broad Valley Rockies, it derives about half of its flow from: (1) the Gallatin and Madison rivers, which receive their water from the Yellowstone Rockies, and (2) the Sun and Marias rivers, which obtain theirs from the Columbia Rockies.

Electric Power Production

The generating capacities of the electric power plants in Montana are given in table 1 and shown on the map in figure 1. On the map, the capacities of hydroelectric plants are represented by proportional circles and those of thermal-electric plants by proportional squares. These data do not include the large thermal-electric plants which are either under construction or planned in the Colstrip area of southeastern Montana and which promise to greatly modify the electric power picture in the state.

For many reasons, actual power production is generally less than generating capacity. Among these are reduced streamflow following dry winters, breakdowns in power plants, variations in demand (electricity cannot be stored on a massive scale), and events in the area of the Bonneville Power Administration far beyond Montana's borders.

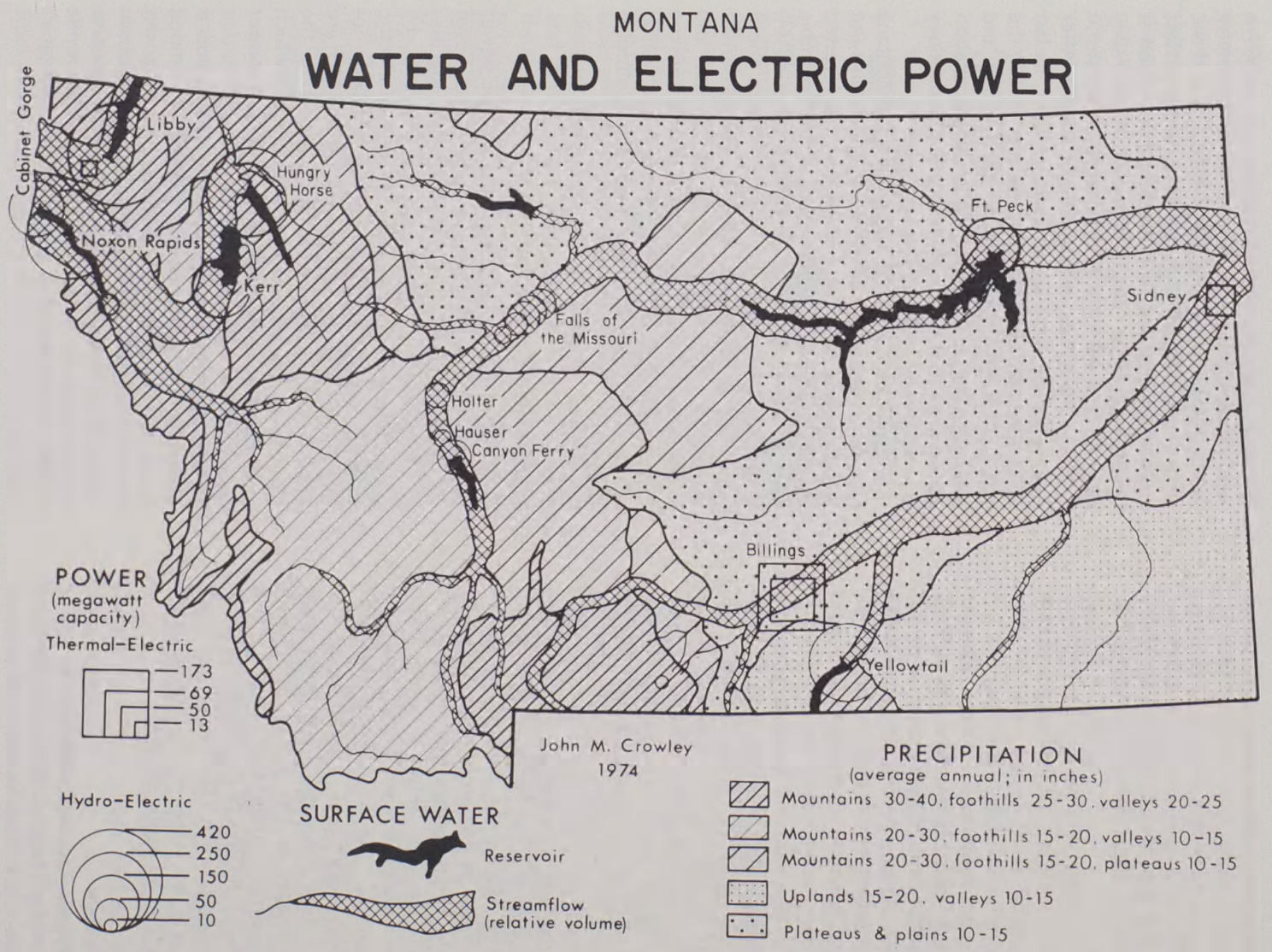


Figure 1. Montana water and electric power

Sources:

Precipitation: U.S. Department of Agriculture, Soil Conservation Service, *Montana Average Annual Precipitation Zones* (map) (Bozeman, November 1970). Streamflow: Nicholas Helburn, M. J. Edie, and Gordon Lightfoot, *Montana in Maps* (Bozeman: MSU Foundation, 1962), p. 23. Power generating capacity: U.S. Department of the Interior, Bonneville Power Administration, *Electric Power Plants in the Pacific Northwest and Adjacent Areas* (map) (Seattle, Washington, December 1970).

Hydroelectric power capacity accounts for 96.8 percent of Montana's total electric power generating capacity. Thus, the electric power picture in the state is mainly one of hydropower, and thermal-electric power is currently of minor importance.

On the national scale, however, Montana's hydropower stations are not very impressive. The entire hydroelectric generating capacity of the Treasure State scarcely exceeds the capacity of Grand Coulee prior to the present expansion there and is only about twice the capacity of a number of other dams on the Columbia River.

Table 1

Generating Capacity of Electric Power Plants in Montana

(In Megawatts)

	Hydro-electric	Thermal-Electric	Total
Columbia producing area	1,386	13	1,399
Libby	420	13	
Hungry Horse	285		
Noxon Rapids	283		
Cabinet Gorge	200		
Kerr	168		
Thompson Falls	30		
Missouri producing area	464		464
Fort Peck	165		
Falls of the Missouri	194		
Cochrane	48		
Ryan	48		
Marony	45		
Rainbow	36		
Black Eagle	17		
Upper Missouri	105		
Canyon Ferry	50		
Holter	38		
Hauser Lake	17		
Yellowstone producing area	260	292	552
Yellowtail	250		
Mystic Lake	10		
Billings		242	
J.E. Corette		173	
Frank Bird		69	
Sidney		50	
Lewis and Clark		50	
Montana total	2,110	305	2,415

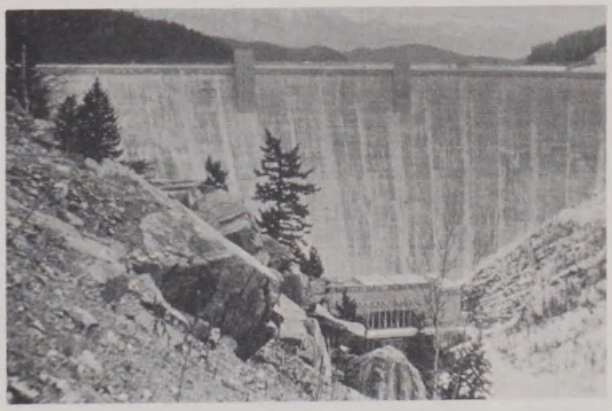
Source: U.S. Department of the Interior, Bonneville Power Administration, *Electric Power Plants in the Pacific Northwest and Adjacent Areas* (map) (Seattle, Washington, December 1970).

Note: Plants with less than 10-megawatt capacity are excluded.

Hydroelectric Power

Hydroelectric power production is a non-consumptive use of water. That is, the water is not consumed or used up by being employed to generate power. As much water flows out of the powerhouse below the dam as entered the penstocks from the reservoir. This does not mean that the water is of the same quality after use or that hydroelectricity is "clean" power.

Construction of the dam brings about a tremendous mechanical impact on the site. The reservoir inundates the preexisting stream and valley slopes, kills the vegetation there, does away with important winter game range, and often requires the relocation of roads, railroads, habitations, and even villages. The water in the reservoir is drastically different—with regard to



velocity, temperature, chemical quality, and aquatic biology—from that of the stream which flowed there before the dam was built. The character of the river, both downstream and for some distance upstream, is greatly modified by the dam and reservoir. The water may have a different temperature, nitrogen content, velocity, and so on after passing through the turbines and entering the stream below the dam. The river usually builds a delta at the head of the reservoir and may have a lower gradient and velocity for an appreciable distance upstream. The shores of the reservoir are very different than the banks of the former stream, provide a different kind of littoral habitat, and so on. A reservoir is much more difficult to bridge

than was the former stream. Finally, the power lines which transmit the electricity from the powerhouse to the consumers greatly disfigure the landscape, especially in mountainous areas, and remove a broad swath of land from most other uses.

Thus, hydroelectricity is not "clean" power, even though the impacts on the environment may be less obvious to the average person than is the smoke from thermal-electric plants and the coal mines which supply those plants.

In defense of hydroelectric power, it may be said that dams and reservoirs usually are aesthetically pleasing, whereas thermal-electric plants generally are not.

Thermal-Electric Power

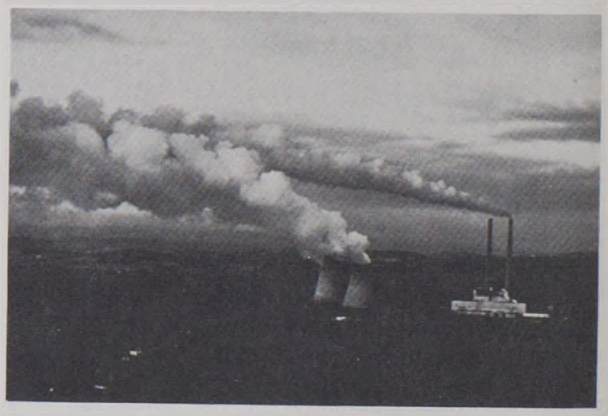
Thermal-electric power is generated by burning fuel to heat water, thereby producing steam which turns the turbines. All of the thermal-electric plants in Montana are conventional plants which use organic fuels, mainly coal. There is no nuclear power plant in the state.

Thermal-electric power plants use huge quantities of water for steam production and cooling purposes. The diversion of water for thermal-power generation is a partially consumptive use. Some of the water is released as steam and not returned to the stream. All of the completed thermal-power plants in Montana are adjacent to large rivers. Obtaining water for the plants at Colstrip, by means of a pipeline from the Yellowstone River, has been one of the most volatile issues in the controversy over their construction.

As in the case of hydroelectric power, the generation of thermal-electric power causes environmental impacts at the site of the plant and by construction of the power lines. In addition, the production of thermal power brings about impacts at the location of the extraction of the fuel. In some cases, as is the plan at Colstrip, the power plant may be built at or near the coal mines. The major impacts at the site of the power plant are: (1) the mechanical impacts on the land resulting from the construction of the plant, (2) smoke and other gaseous emissions into the atmosphere, and (3) the use of water. In the case of the last, the withdrawal of the water modifies the flow and biology of the stream. While being used for cooling purposes, the water is itself heated. Even though an attempt may be made to let the water cool before returning it to the stream, it is usually quite different in temperature and biological properties when released to the stream than when withdrawn. The river is affected for a considerable distance downstream from the plant.

Spatial Pattern of Generating Capacity

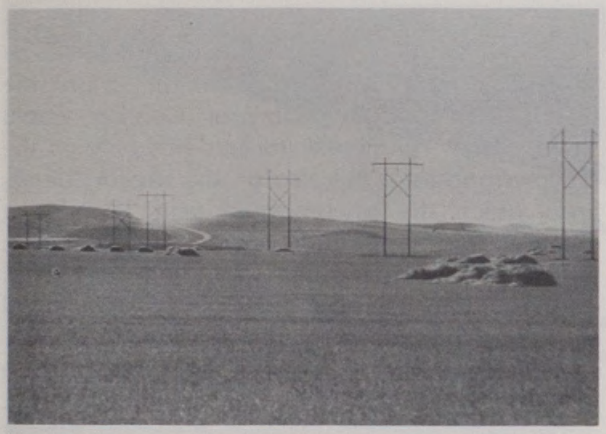
The production of electric power in Montana may be viewed in the framework of three producing areas corresponding to the three streamflow systems examined earlier. Table 1 is organized according to these three producing areas.



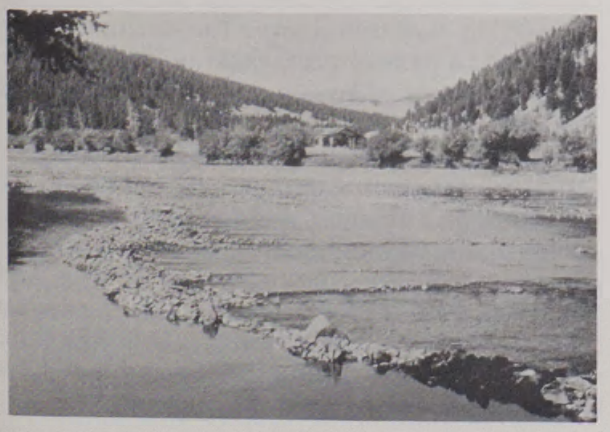
Columbia Producing Area

It is not surprising that the lion's share of the state's electric generating capacity is located in northwestern Montana, where the largest streamflow occurs in the mountainous portion of the state. The narrow valleys of this area provide excellent hydropower sites, and because of the sparse population it was unnecessary to relocate large numbers of habitations to make way for reservoirs.

The Columbia Producing Area has 66 percent of the hydroelectric generating capacity of the state and 58 percent of the total capacity. It contains five of Montana's seven largest power plants. The powerhouse at recently completed Libby Dam is the largest in capacity, followed by those at Hungry



Horse, Noxon Rapids, Cabinet Gorge, and Kerr. The construction of Libby Dam, whose reservoir is called Lake Koocanusa, necessitated the relocation of the village of Rexford. Hungry Horse was one of the tallest dams in the world when constructed. Cabinet Gorge Dam is just across the state line in Idaho, but most of the reservoir is in Montana and all of the water that generates power there comes from Montana. Although Kerr Dam is located in the Flathead arm of the Broad Valley Rockies, virtually all of the water that turns its turbines comes from the Columbia Rockies to the east and north. The construction of Kerr Dam raised the level of Flathead Lake, technically making a reservoir of the former lake. Only Yellowtail Dam and one of the thermal-electric plants at Billings are in the same league with these giants of Montana's electric power industry.



The hydropower plant at Thompson Falls and the small thermal-electric station at Libby, which uses sawmill refuse as fuel, complete the electric power picture in northwestern Montana.

Missouri Producing Area

The power plant at Fort Peck is the largest on the Missouri River in Montana. The dam is a long but low earth-fill type, which created the largest reservoir in the Treasure State. The combined generating capacity of the five dams at the Great Falls of the Missouri is somewhat larger than that at Fort Peck. Black Eagle is the oldest, smallest, and most upstream of these dams. The others, in a downstream direction, are Rainbow, Ryan, Cochrane, and Marony. The remaining sizeable dams on the Missouri are in the Helena-Townsend Valley and in the gorge near the Gates of the Mountains. Canyon Ferry is the largest, and their combined generating capacity is only about half that at The Falls.

The generating capacity of the Missouri Producing Area, which includes no thermal-electric plants, is about 19 percent of Montana's total electric generating capacity.

Yellowstone Producing Area

It is noteworthy that all of the largest thermal-electric plants in Montana are in that part of the state most remote from the major hydroelectric power area in northwestern Montana. The largest plants are both in Billings, making the Midland Empire city temporarily the "thermal-electric capital" of the Big Sky Country. It is true that these stations are near Yellowtail Dam, but they were built before the construction of that dam. Yellowtail, in the Bighorn Mountains, is the fourth largest power plant in Montana; but thermal-electric power is predominant in the Yellowstone Producing Area. The generating capacities of the J. E. Corette and Frank Bird thermal plants at Billings, together with that of the Lewis and Clark station at Sidney, exceed the capacities of the Yellowtail and Mystic Lake hydroelectric plants.

The Yellowstone Producing Area accounts for nearly all of the thermal-electric power in Montana but only about 12 percent of the hydropower capacity and 23 percent of all generating capacity. The construction of the plants at Colstrip will greatly change this picture and increase the predominance of thermal-electric power in southeastern Montana.

The Outlook

A glance at the map in figure 1 reveals that, although relatively little water flows into Montana from neighboring states and provinces, a great deal of water flows out of the state. Despite the water deficiency in Great Plains Montana, the water surplus in Rocky Mountain Montana is so great that, even after consumptive uses, there is a substantial involuntary exportation of water from the Treasure State.

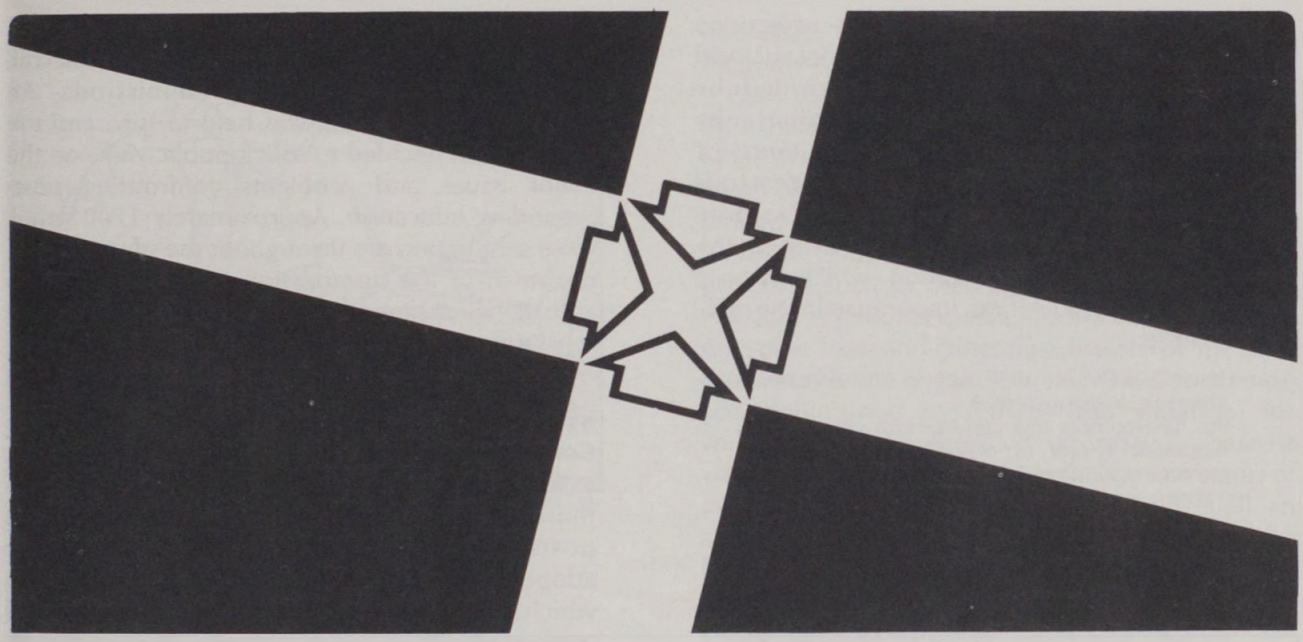
The outflow would be reduced by increasing the consumptive use of water within the state. The major consumptive use of water is for irrigation. The lands easiest to irrigate are already under irrigation. It would be quite expensive to get water onto the remaining irrigable areas. Costly engineering works to irrigate additional lands may become more feasible if the world food situation continues to worsen.

The most dramatic additional or different use of water is likely to be that for the thermal-electric plants in southeastern Montana that are to be fired by coal strip-mined in that area. These plants will require the diversion of large amounts of water from rivers and reservoirs; some of the use will be consumptive. Diversion of water from the Yellowstone to the plants at Colstrip would produce environmental impacts not only on the Yellowstone itself but also on the stream courses into which the unconsumed water would be released after being used for cooling. Moreover, water may be needed for the successful rehabilitation and revegetation of strip-mined lands in dry areas such as eastern Montana.

If the outflow of water from Montana were greatly reduced, the results would be quite drastic for other areas of the continent. Were it not for Big Sky water, hydroelectric power production would be lower on the Columbia system in Washington, Oregon, Idaho, and British Columbia, and on the Missouri River in the Dakotas and Nebraska. Moreover, Treasure State water contributes to irrigation in the Columbia Basin and is used for domestic and industrial purposes, waste disposal, navigation, and wildlife in many areas downstream from Montana's boundaries.

Periods of low flow constitute one of the most critical aspects of the question. Streamflow fluctuates widely from year to year and from season to season, especially in eastern Montana. If a streamflow map were made for a dry year, the flow lines would be much more narrow than those on the map in figure 1. A map of streamflow during a month of low flow, following a winter having light snowfall, would be even more dramatic. If Yellowstone water is overcommited, there will come a time in a late summer month following a dry winter when the demands for water equal or exceed the flow of the river! The situation would not have to deteriorate to that point for the river level to become dangerously low for aquatic and littoral wildlife.

If Montanans wish to ensure adequate water for all uses—agriculture, industry (including power production), recreation, and domestic—in all areas of the state, care must be exercised in its allocation. The determination not to permit unwise and destructive use of Montana water, as evidenced by recent legislation and growing public concern, indicates that Montanans understand just how important this vital resource is.



Montana Postsecondary Education at the Crossroads

PATRICK M. CALLAN

Patrick M. Callan is former Director of the Montana Commission on Post-Secondary Education.

How the Commission's intensive study was conducted

On December 1, 1974, the Montana Commission on Post-Secondary Education will present its final report to the governor, the legislature, and the State Board of Education. The report will be the product of the most exhaustive and expensive study of education in the history of the state. Because the Commission's findings and recommendations are likely to command the attention of the people of the state and state-level policy makers for some time, it may be useful to review the origins of the Commission, its mandate, the way it went about its work, and the preliminary findings of the Commission in its draft report issued in September 1974.

Trends in Postsecondary Education

Historians will probably look upon the Commission's work as one of a series of efforts undertaken by Montanans to streamline government and enhance its responsiveness in the 1970's. These efforts include adoption of a new

constitution, reorganization of the executive branch, and assessment of the effectiveness of local government. Of all the services provided by government, furnishing educational opportunity ranks among the most critical both in terms of education's intrinsic importance and its demands upon state financial resources.[1] In addition to these general concerns, specific developments in the area of postsecondary education, which make a reevaluation desirable if not imperative in the mid-70's, include:

—severe enrollment decreases in the six-campus Montana University System
—the development and rapid growth of a publicly supported system of postsecondary vocational-technical institutions
—indications of increased demands for postsecondary education on the part of adults
—a new system of governance under a new constitution
—new insights into the need for educational reform developed by such national study groups as the Carnegie Commission on Higher Education, the federally sponsored Newman Task Force on Higher Education, and the Commission on Non-Traditional Study
—escalating costs of education
—demands on the part of the public and its representatives for greater accountability
—new modes of instruction, some related to potential applications of educational technology
—increasing popularity of vocationally- and occupationally-oriented education among many students in the 18- to 24-year-old group

These developments and trends portend the emergence of new sets of problems and new challenges for postsecondary education. It is already clear that the decades of the 1970's and 1980's will differ markedly from the 1960's. By 1973 it had become apparent to many Montanans that the times were ripe for a comprehensive study of the state's system of higher education and its capacity to meet future needs.

Establishment and Organization of the Commission

The Montana Commission on Post-Secondary Education was established by the 1973 Montana Legislature at the request of Governor Thomas L. Judge. By mid-1973 the governor had appointed all thirty members of the Commission. An organizational meeting was held in July, and the Commission decided to solicit public views on the major issues and problems confronting post-secondary education. Approximately 1,800 letters were sent to persons throughout the state, and the chairman of the Commission made several radio and television appearances urging Montanans to send their views to the Commission.

By October the public input had been reviewed by the Commission and synthesized by the Commission staff.[2] On the basis of this information, its own deliberations, the legislative mandate, and a thorough review of all previous studies of Montana postsecondary education, the Commission adopted a study plan setting forth the issues with which it would deal and the principles and methodologies of the study.[3]

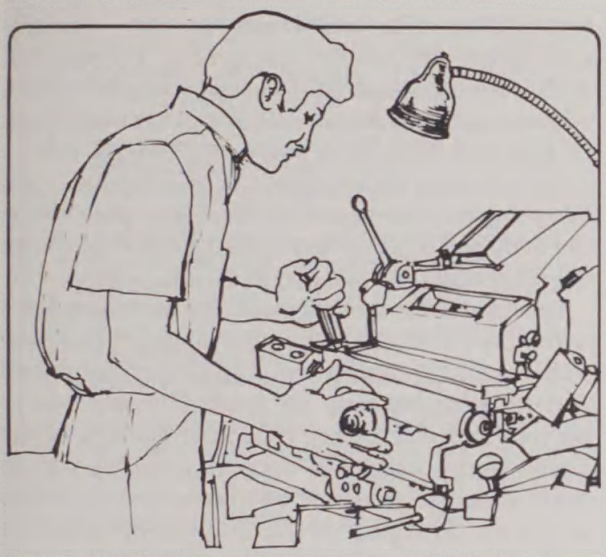
The issues identifed in the study plan comprised four pages of questions. Some of the major policy questions were:

- What goals, objectives, and priorities should be set for the future of Montana postsecondary education?
- What should our institutions and systems of post-secondary education be held accountable for?
- How should responsibility for meeting the state's postsecondary education goals be divided among our institutions?
- How many institutions of postsecondary education are required to meet our goals?
- How should postsecondary education be governed?
- What kinds of coordination should exist between secondary and postsecondary education?
- Are our planning processes adequate to assure continuous adaptation to changing state, societal, and student needs?
- Should traditional campus-type units continue to be the primary postsecondary delivery systems in Montana?
- Are there sufficient opportunities for time-shortened degrees and certificates (e.g., 3-year B.A.; challenge examinations)?
- How should financial responsibility for post-secondary education be allocated?

[1]Postsecondary education accounted for 35.3, 31.4, and 29.1 percent of state general fund and millage expenditures in fiscal years 1972, 1973, and 1974 respectively.

[2]*Staff Report No. 2: Montana Post-Secondary Education, Issues and Questions* (Helena, September 1973).

[3]*Staff Report No. 1: Review of Prior Studies of Montana Post-Secondary Education* (Helena, September 1973); and *Study Plan of the Montana Commission on Post-Secondary Education*, adopted October 1, 1973.



In addition to identifying the crucial issues, the study plan included the methodology and time table for the study. The Commission divided its work into four phases:

Oct. 1973 through May 1974 ... Information Gathering
June and July 1974..... Development of Draft Report
Sept. 1974..... Public Hearings on Draft Report
Oct. and Nov. 1974 ..... Adoption of Final Report

The information gathering phase was the heart of the Commission's work. It involved three components: eleven public hearings throughout Montana to gain public views of postsecondary education; a series of studies conducted by the Commission's staff, some with the assistance of outside consultants;[4] and twelve studies conducted by technical advisory groups to the Commission, consisting of representatives of postsecondary education, various state agencies, and other interested parties including legislators and secondary school administrators.[5]

Prior to the existence of the Commission, very little information on postsecondary education had been systematically collected at the state level. Most of the data that had been collected was limited to information used in the development of biennial budgets, reports required by federal programs such as the Higher Education Facilities Act, and occasional special studies conducted on a one-time basis and generally obsolete by the time the Commission began its work. The Commission was determined to remedy this situation, for without a comprehensive information base it would be impossible to assess the current status of postsecondary education; and without such an assessment, planning for the future would be based, at best, on guesswork. Equally important, without a factual framework policy deliberations would most likely center on exclusively political considerations. Finally, the Commission believed that the institutions of postsecondary education would reap spin-off benefits in improvement of internal management from participation in intensive data gathering and analytical projects.

The decision to devote a large proportion of the Commission's time and resources to information gathering was critical. It symbolized a commitment to undertake a careful study of postsecondary education which would not be dominated by preconceptions or personal bias. It reflected a determination to be as fair and as objective as possible. It meant that no decisions would be made until the facts were in.

Some of the information collected by the Commission through its studies included enrollment and fiscal trends; enrollment projections; inventories of all program offerings

[4]In addition to those cited earlier, staff studies included: *Staff Report No. 3: Montana Post-Secondary Education Today; Staff Report No. 4: Student Needs and Resources in Montana Post-Secondary Education (SRS); Staff Report No. 5: Goals for Montana Higher Education: A Survey of 12 Academic Communities; Staff Report No. 6: Educational Plans of Montana High School Seniors; Staff Report No. 7: Vocational-Technical Student Survey; Staff Report No. 8: Issues in Governance, Planning and Coordination; Staff Report No. 9: Montana Proprietary Schools; Staff Report No. 10: The Montana Native American and Post-Secondary Education;* and *Staff Report No. 11: Staff Recommendations Presented to the Commission on Post-Secondary Education.*

[5]The advisory groups were: The Technical Group on Accountability, the Technical Group on Adult and Continuing Education, the Technical Group on Faculty Research, the Technical Group on Fiscal and Budgetary Information, the Technical Group on Health Care Education, the Technical Group on Independent Higher Education, the Technical Group on Manpower Planning, the Technical Group of Programmatic Planning, the Technical Group on Relations Among Post-Secondary Units, the Technical Group on Relations Between Secondary and Post-Secondary Education, and the Technical Group on Student Enrollments.

and degrees granted since 1966; credit hour costs by level of instruction for all programs in public postsecondary education; a study of how students are currently financing postsecondary education; a survey of the beliefs of students, faculty, administrators, and community people regarding the goals of their postsecondary institutions; surveys of the educational plans of high school seniors, of adult and continuing education offerings; and studies of faculty research, health care education, independent (private) higher education, cooperation among postsecondary education units, and relationships of post-secondary and secondary educational institutions.

In late 1973 and during the early months of 1974 the various studies and the public hearings proceeded.[6] Meanwhile the Commission sought to deepen its understanding of postsecondary education. Commission members reviewed numerous national studies including several of the reports of the Carnegie Commission on Higher Education, the work of the Newman Task Force on Higher Education, the final report of the Commission on Non-Traditional Study, and many books and articles. The Commission also held a two-day seminar on issues in postsecondary education in which nationally recognized authorities participated. The staff prepared a series of presentations on such subjects as national trends in postsecondary education, the federal role in postsecondary education, accountability, and financing in postsecondary education. In addition the staff periodically distributed a digest of recent developments in postsecondary education.

By May 1974 the public hearings were completed and most of the staff and technical studies had been published and distributed. The Commission held two lengthy meetings in June. The first was to receive and discuss the recommendations of the Commission staff; the second meeting was to discuss, debate, and vote on the recommendations which would appear in the Commission's draft or preliminary report.[7]

The Draft Report

The purpose of the *Draft Report* is to subject the findings and recommendations of the Commission to public scrutiny and debate.[8] The report itself is 158 pages in length and consists of ten chapters containing 145 recommendations. Rather than attempting to summarize the document in this brief article, I will discuss some of its principles and their implications. Each of the specific recommendations follows from one or more of these principles.

1. **Access to postsecondary education.** The state's responsibility to provide access to postsecondary education for all persons who desire and can benefit from it has quantitative and qualitative dimensions. Simply providing spaces somewhere within the postsecondary system is not sufficient. If access is to be meaningful, it must be access to an educational experience which enables the student to fulfill his or her individual goals.
2. **Diversity.** The diversity of student educational needs, goals, and learning styles should be reflected in a pluralistic system of postsecondary institutions. Montana should continue to maintain a broad spectrum of institutional types including public universities, state and community colleges, independent (private) colleges, vocational-technical centers, and proprietary schools.

[6]Public hearings were held in Billings (January 24, 1974), Bozeman (February 7, 1974), Butte (February 14, 1974), Glendive (February 28, 1974), Havre (March 14, 1974), Helena (March 19, 1974), Glasgow (March 21, 1974), Kalispell (March 26, 1974), Missoula (March 28, 1974), Dillon (April 2, 1974), and Great Falls (April 9, 1974).

[7]*Draft Report of the Montana Commission on Post-Secondary Education* (Helena, September 1974).

[8]Public hearings on the *Draft Report* were held in Helena on September 24 and 25, 1974.

3. **Quantity versus quality.** Neither access nor pluralism can be meaningful unless educational offerings are of high quality. In a time of scarce resources and declining enrollments in some sectors, it will be necessary to close some institutions and to consolidate some programs in order to achieve the concentrations of resources necessary for high quality. The Commission took note of the tendency for cost per student to rise as enrollments, staffing, and curricular offerings decrease, particularly at small institutions. In short, the quality of programs is more important than the quantity so long as the total postsecondary system provides sufficient opportunity and diversity to meet the state's needs.
4. **Statewide versus parochial interests.** Meeting the overall needs of the state for postsecondary education must take precedence over the interests of particular programs, institutions, or communities. To put it another way, the public interest and the interests of particular constituencies do not always coincide.
5. **Duplication.** Unnecessary duplication of educational programs and services must be systematically rooted out by continuous reappraisal. This is an ongoing responsibility of governing boards.
6. **Governance.** The letter and spirit of the new Montana Constitution should be observed, particularly with respect to the authority of the Board of Regents to supervise, coordinate, manage, and control the Montana University System, and the responsibility of the State Board of Education for long-range planning.
7. **Leadership for change.** Many improvements can be made in the quality of postsecondary education, the coordination of secondary and postsecondary education, and provision of greater educational opportunity for adults through policies which can be effected at the institutional and board levels. What is most urgently required in these instances is leadership, not legislation or funds.
8. **Quality and efficiency.** Some innovations, such as the three-year bachelor's degree, can improve the quality of education while realizing economies for the state.
9. **Innovation as a priority.** Innovation will be more difficult in a period characterized by stabilized and declining enrollments, particularly in colleges and universities. In order to ensure that we continue to look for new and better ways of providing educational opportunity, innovation must become an explicit priority of the state, governing boards, and institutions of postsecondary education.
10. **Continuous planning.** Planning must be an ongoing process. In a world of future shock and rapidly changing societal needs, it no longer makes sense to limit planning to special studies and commissions created every ten or fifteen years. While periodic reviews are desirable, they will be of little value unless institutions, systems, and governing boards are involved in continuous planning and revision and updating of plans.

Montana at the Crossroads

As the people of Montana and their elected representatives consider the Commission's work, two questions seem relevant:

- Was the Commission's work conducted in an open, participatory, and objective manner?
- Do the Commission's conclusions and recommendations constitute an acceptable blueprint for the future of Montana postsecondary education?

My belief that the answer to the first question is affirmative is by now clear to the reader. As for the second question, it seems fair at this point to say that the verdict is still out. A vigorous public discussion of the Commission's conclusions will be healthy for postsecondary education and for the state of Montana. However, it is critical that such discussion be placed in the context of the present and future needs of the people of Montana for postsecondary education. This is the perspective the Commission attempted to achieve. The greatest pitfall in planning is the uncritical assumption that what worked in the past will automatically be sufficient in the future.

After more than a year of intensive study, I have no doubt that on the whole the people of Montana have been well-served by their institutions of postsecondary education. But past achievements must not be permitted to lull us into complacency. As Peter Drucker has stated,

> No success . . . is "forever." Yet it is far more difficult to abandon yesterday's success than it is to reappraise failure. Success breeds its own hubris. It creates emotional attachment, habits of mind and action, and, above all, false self-confidence. A success that has outlived its usefulness may, in the end, be more damaging than failure.[9]

Perhaps the incorporation of this perspective in public policy for postsecondary education is more important than any of the commission's specific recommendations. The vitality of Montana post-secondary education in the last quarter of the twentieth century will depend largely on whether we have the courage to reassess.

[9]Peter E. Drucker, *Management: Tasks, Responsibilities, Practices* (New York: Harper and Row, 1973), p. 159.

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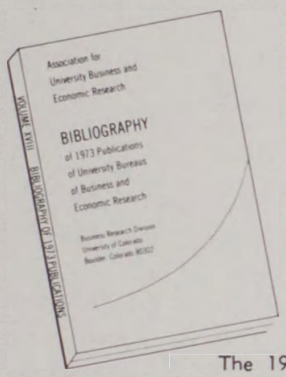

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